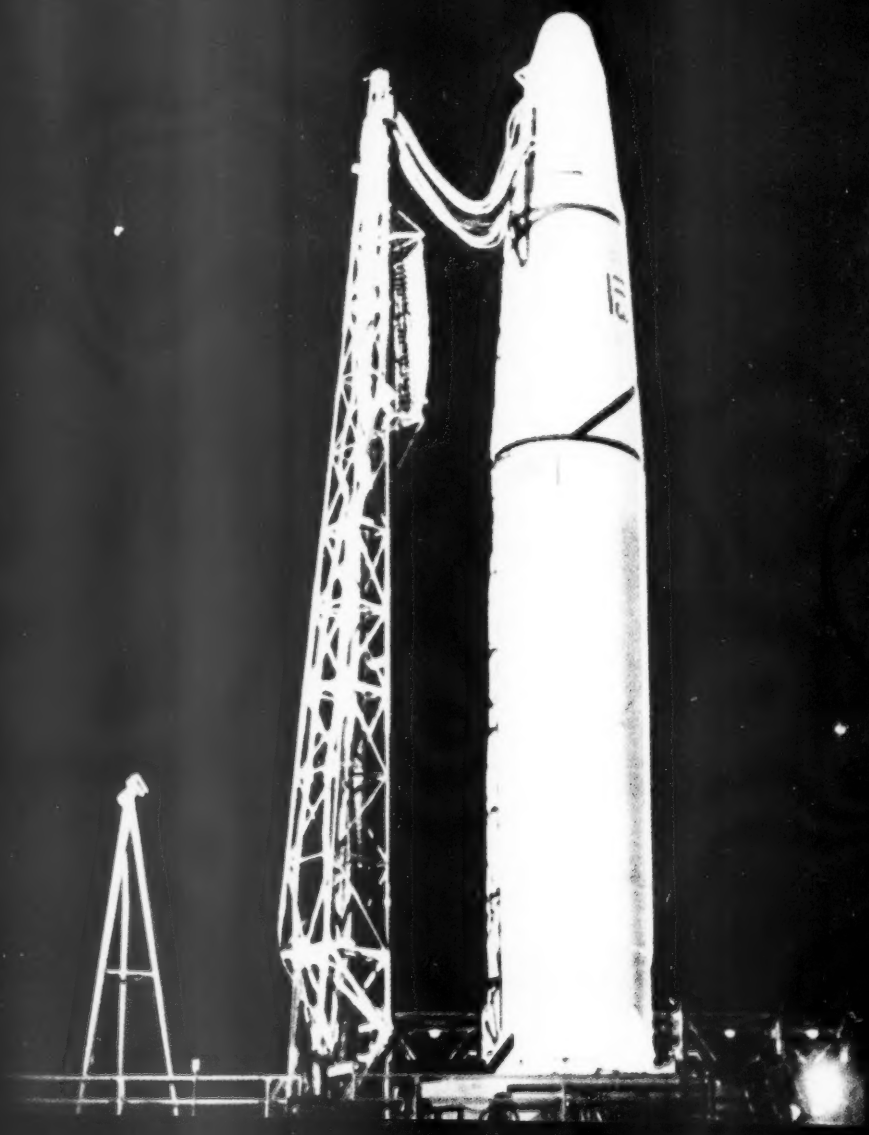
APRIL 1954

the Airman

OFFICIAL JOURNAL OF THE AIR FORCE



Greater love hath no man than this, that a man lay down his life for his friends.

Christ's Farewell Sermon, St. John 15:13

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THE AIRMAN is primarily a medium for the exchange of ideas and information among Air Force personnel. Readers are encouraged to submit articles, short subjects, photographs and artwork. All contributions will be given consideration; suggestions and criticisms are welcomed. Opinions expressed by individual contributors do not necessarily reflect the official viewpoint of the Department of the Air Force. All photographs are official USAF photos unless otherwise designated.

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AIR FORCE ROLE IN SPACE

Excerpts of an address by General Thomas D. White, Chief of Staff, at AFA Jet-Age Conference, 28 Feb., 1958.

Space is the Air Force's Natural Element

. . . I look upon the Air Force's interest and ventures into space as being as logical and natural as when men of old in sailing ships first ventured forth from the inland seas into the great oceans. As these ancient seafarers gained knowledge of the inland seas and learned more about the elements, they built larger ships and ventured further away from land. This achievement required men who had learned the many things there were to know about the inland seas. Similarly, ventures into space require men who know the air. There are no barriers between air and space. Air and space are an indivisible field of operations.

Air Force progress toward space has been evolutionary —the natural development and extension of speed, altitude, and sustained flight. These qualities have been our stock in trade throughout the 50 years of Air Force history. We have strived continually to fly faster, to fly higher, and to remain airborne longer.

. . . The evolutionary process which has brought the Air Force to its present high state of development is not going to change in direction because there are additional challenges in space. Aeronautics and astronautics are closely allied. Our progress in both is dependent upon the same questing spirit that has always been typical of the Air Force.

Actually, the Air Force has been penetrating the fringes of space for several years with manned aircraft. Men like Yeager, Everest, Apt, and Kincheloe have been our pioneers. The X-15 rocket research plane which is now under development, as a joint effort on the part of the Air Force, the Navy, and the National Advisory Committee for Aeronautics (NACA), will be our first true spacecraft.

It is expected to travel at speeds of a mile a second and altitudes of more than a hundred miles above the earth. It is only a step away from manned orbital flight. . . .

A strong consideration as far as military space operations are concerned will always be the necessity for a fail-safe concept. A substantial proportion of our forces must maintain the capability to make last-second decisions. This is one reason I am convinced that man in space will be a most important factor.

Ninety-nine percent of the earth's atmosphere lies within 20 miles altitude above the earth. To assure effective operations, there can be no division in responsibility between the control of the air up to 20 miles above the earth's surface and the space above it. Air Force facilities, communications, and experience exist now for centralized control of operations in the earth's atmosphere. This capability can easily be extended beyond the earth's atmosphere as our operations in space develop.

Conclusion

. . . I want to stress that I cannot conceive that mechanical gadgets will control space. Man will. Man will develop the equipment, send it off, and bring it back. On many occasions, and probably more than we envision now, man will fly the equipment. The point here is that man's judgment and skills will always be needed to achieve the greatest effectiveness.

The Air Force's previous probing into the fringes of space has been a natural progression from its activities in the earth's atmosphere. In the very near future, airmen with experience and knowledge gained through operations at lower altitudes will conquer space. To assure that the United States gains and maintains the capability to control space should be the goal of all Americans.

Letters to the Editor

★ ★ ★

THANK YOU

Sir: *As a means of improving your otherwise fine publication, I suggest you change the dating system.*

Our January issues reached us in February thus placing THE AIRMAN *at a psychological disadvantage of being a "month late."*

Lt. Nick P. Apple
Panama City, Fla.

Your point is valid. The "dating" of THE AIRMAN was a result of changing from 52 to 32 pages and the additional negotiations required. March-April have been combined and we have returned to a 52-page publication. In the future we plan to be printed no later than the middle of the month preceding the dateline.

AFSC FUTURE

Sir: *I carry an AFSC of 42372 and am in charge of a fuel control section. At present, North American's F-86 is the only USAF aircraft utilizing the electronic fuel control system.*

I understand that all F-86 aircraft are going to the Air National Guard or to storage and I am curious about whether my AFSC will become surplus to Air Force needs.

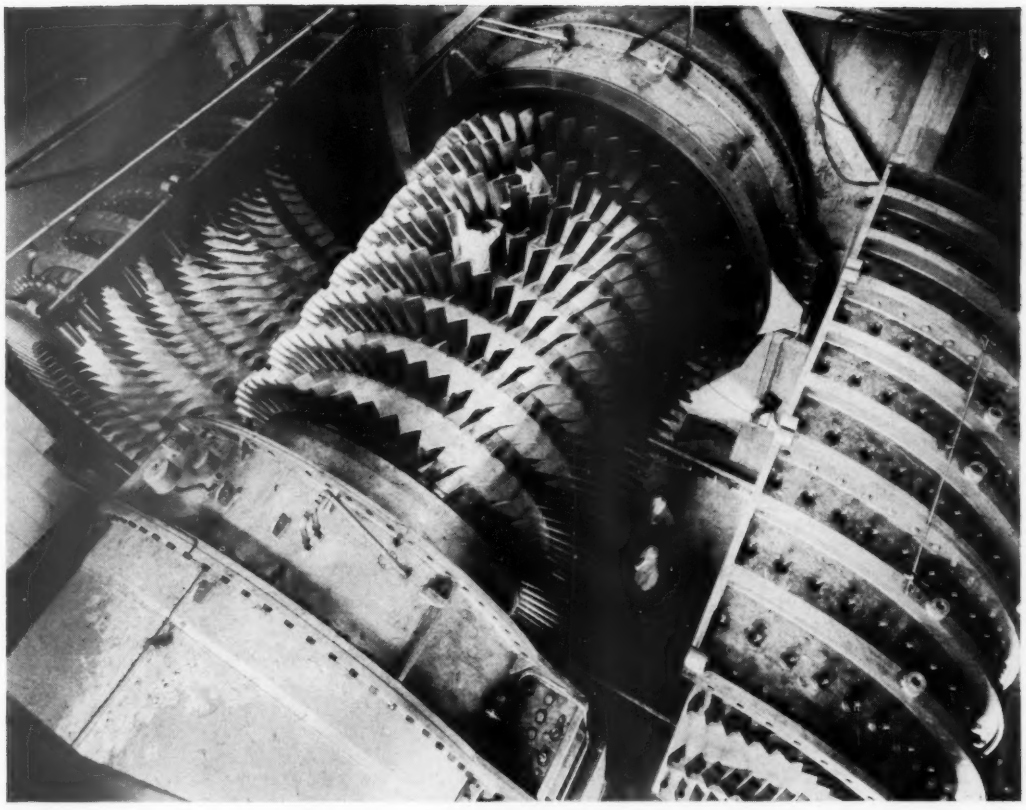
Also, I would like to know whether the 42372 field will be considered for transition into missile and related systems. I have been doing rather extensive reading and have concluded that present systems are basically the same, though more advanced, and that transition would be comparatively simple.

T/Sgt. Louis Olsen
Castle AFB, Calif.

Career Development Division, DCS/P, Hq USAF advises that AFSC 42372 is not surplus nor is it projected to be surplus to USAF needs at the present time.

If and when it does reach that status, present policy is to retrain and reclassify qualified personnel into closely related career areas. Should your career field become surplus at a future date, a change will be published to AFM 35-1 which will provide a guide to conversion.

The skills of many career fields are employed in the operation and maintenance of missiles. The training of these personnel is coordinated to make the best use of many skills which are currently surplus to Air Force needs. AFR 39-8, as amended, provides detailed information regarding this retraining program and how the individual may fit into the program. Also, extension course training, details of which are contained in AFR 50-12, is available to personnel desiring training in their own or other career fields.



PHOTOS COURTESY OF NACA

Top view of main compressor of NACA's Lewis Unitary Plan Wind Tunnel, fully bladed, prior to assembly of two stator halves. Four electric motors totalling 150,000 h. p. drive this eight-stage compressor to deliver 2,000 pounds of air per second at a pressure ratio of 2.8.

SPACE TECHNOLOGY

The work and role of the National Advisory Committee for Aeronautics

by John W. Crowley, Jr.
Associate Director for Research, NACA

LAUNCHING artificial earth satellites is a major event in modern history. Where this accomplishment will lead us, man can only speculate. Yet, there can be little disagreement in the United States with the statement recently made by Lt. Gen. Donald L. Putt, USAF Deputy Chief of Staff for Development: "It is our judgment that a first order objective of our national research and development effort must be to demonstrate manned space flight at the earliest possible date."

Before recounting some of the work on the problems of space flight already done by the National Advisory Committee for Aeronautics, and describing the purpose and operations of the NACA it may be important to note another pertinent statement by General Putt: "There is no basis for the argument that there is any essential difference between aeronautics and astronautics. The latter is only a part of the larger whole. Aeronautical science embraces the flight of any vehicle that leaves the surface of the earth and goes anywhere, by whatever means."

Remember the basic components of the first successful airplane, the one Wilbur and Orville Wright flew some 54 years ago, were the structure, the powerplant, and the control system. These same components are with us today, in both manned and unmanned vehicles. They will be the basic components in tomorrow's vehicles, the boost-gliders, satellites, and manned space craft.

Upstream view of No. 2 cooler of Lewis Unitary Plan Wind Tunnel. Heat added to tunnel air during compression requires that air be cooled to prevent continuous temperature rise.

A plasma jet of ionized air, hotter than the surface of the sun, disintegrates a small aircraft model. This laboratory device is useful in the study of aerodynamic heating problems.

Any vehicle, no matter how many thousands of miles an hour it attains or how far into space it travels, must start from earth and accelerate from zero speed. It will have to pass through the subsonic, transonic, and supersonic speed ranges. Its early flight will be within the atmosphere. Similarly, on its return to earth from a space flight, any vehicle will have to decelerate on reentering the atmosphere. It must be able to land safely at low speed.

Already we have a substantial fund of knowledge useful in the achievement of any flight goal. We must expand rapidly our knowledge in regions that now are familiar. We must, in addition, penetrate boldly and vigorously into areas still unexplored.

For the past 43 years—the agency was established March 3, 1915—the NACA sought to provide the scientific basis that would enable man to fly faster. farther, and higher. As stated in the original act of Congress, the NACA was given the task to "supervise and direct the scientific study of the problems of flight, with a view to their practical solution, and direct and conduct research and experiments in aeronautics."

The National Advisory Committee for Aeronautics consists of 17 members, appointed by the President. These men meet monthly, and function much as does a board of directors of an industrial corporation. They set policy. They plan in broad outline the research programs to be carried out by the nearly 8,000 scientists, engineers, and supporting personnel who operate the NACA's three large laboratories and two smaller field stations.

"Jimmie" Doolittle is chairman of the committee. His outstanding record in uniform is too well known to require mention here. So is the long list of speed and distance marks he established back in the 20s and 30s. Less well known is his earned doctorate of science degree from M. I. T. That degree, and that competence in science, helps explain why, in addition to his NACA responsibility, General Doolittle is a member of the Killian Committee advising the President, chairman of the Scientific Advisory Board of the USAF, and works on numerous other government scientific boards and committees. He is also a vice president of Shell Oil Company.

Two members of the NACA are from the Air Force. Consistently, these Air Force members have been at the very top of the command ladder . . . Arnold, Spaatz, Vandenberg, and Twining. Today, the Air Force is represented on the NACA by General Thomas D. White, Chief of Staff, and General Putt.

Since 1915, one of the major tasks of the NACA has been coordinating flight research in the United States. Through the membership of the main committee and its 28 technical subcommittees, NACA links the military and civil government agencies concerned with the problems of flight. More than 400 men (including many from the Air Force) are selected for such committee service, for reasons of technical ability, experience, and recognized leadership in a special field. They serve without pay, in a personal and professional capacity.

The paid staff of the NACA is headed by a director. Since 1948 that position has been held by Dr. Hugh L. Dryden, internationally known for his work in aerodynamics. In the late 20s, Dr. Dryden performed some of the earliest research in the United States on problems in the low supersonic speed range. During World War II, among other researches, he worked on problems of guided missiles.

Space Age

Since the end of World War II, the NACA has been engaged increasingly in research directly applicable to the problems of space flight, and, at its laboratories, has designed and constructed complicated special facilities required for this work.

For example, before controlled flight into space can become a reality, it is necessary to study propulsion systems under conditions likely to be found beyond the earth's atmosphere. At these extreme altitudes, air-breathing engines will not operate. Therefore, space engines must be capable of operating in what may be virtually a vacuum. In re-entering the atmosphere, future missiles and space craft will be exposed to frictional heat that may generate temperatures as high as 30,000 degrees F. What makes laboratory simulation of such conditions so extremely difficult is that these tremendously high temperatures drastically change the behavior of matter in the thin, upper atmosphere. To simulate such conditions it has been necessary to develop new, high-temperature, research facilities.

One such laboratory facility is the electric-arc tunnel in which a high current is made to discharge in an arc chamber. When a working fluid, perhaps air, is injected into the chamber it is heated by the arc. This fluid then is expanded through a specially shaped nozzle to produce a high-speed stream at temperatures of from 10,000 to 20,000 degrees F. Re-entry problems are being studied in this facility; this particular research tool has a distinct advantage in that it can be operated for usefully long periods of time at high speeds and high temperatures.

Another device developed by NACA scientists and engineers was announced earlier this year. Called an "atmosphere entry simulator," its main element is a trumpet-shaped nozzle through which air at supersonic speed undergoes changes in density from one end of a 20-foot passage to the other. The model of a missile or space vehicle is launched against the supersonic air stream from a high velocity gun. While flying through the nozzle test chamber, the model encounters air of increasing density, thus duplicating the re-entry flight course of a full-scale vehicle. The simulator can provide an accurate variation in density over a range of 100,000 feet. It can be used to study re-entry problems at altitudes up to a maximum of 200,000 feet.

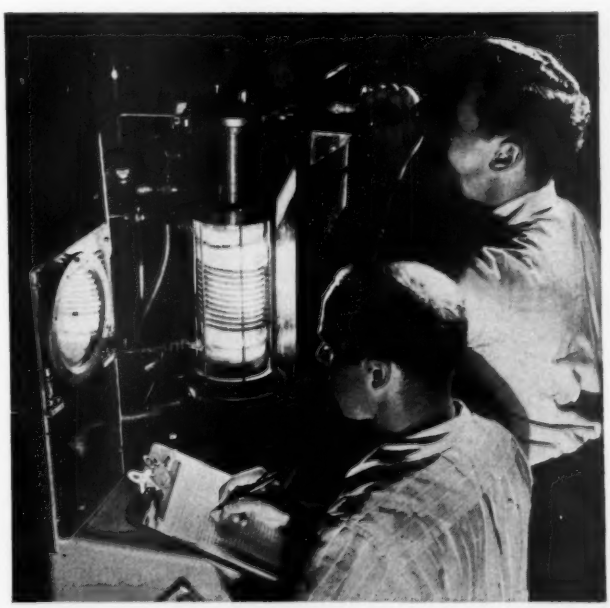
Externally, the re-entry simulator is no more spectacular than the maze of pipes and valves to be seen at any oil refinery. Nonetheless, even though the models used are very tiny, full-scale answers are possible. A model only 0.36 inches in diameter and weighing only 0.005 pound can simulate the re-entry flight of a full-scale 4,000-mile-range missile of 3-foot diameter and weighing 5,000 pounds.

The question may be asked, why it is necessary for all this further study of the re-entry problem if, as the NACA disclosed a year ago, the basic solutions are known? The answer is that after a solution to a very difficult problem is found, it often is necessary to do a great deal of additional work to refine that solution. The Wright brothers solved the problem of mechanical flight in 1903, but very large effort over many years was required before the airplane became an efficient vehicle.

In the case of the re-entry problem, until 1952 the effort of the ballistic missile designers had been to design their warheads with a sleek, pointed shape. This was fine from the standpoint of aerodynamics, but the air-friction problem was so great that there was grave concern whether it could be licked. H. Julian Allen, a scientist at the NACA Ames Aeronautical Laboratory, that year came up with a new concept. He suggested that if the warhead was given a blunt shape, as much as 99 percent of the heat produced by air friction would be dissipated in the region of the strong shock wave that formed during re-entry. Allen's work proved theoretically possible. Since 1952, it has been proved experimentally and today all our ballistic missiles, both IRBMs and ICBMs, use Allen's concept.

What now has to be done is to provide refinements so that the warhead won't be slowed down too much during re-entry. This is important, because strong upper-atmosphere winds can blow the warhead off its target course if it is slowed down too much. Furthermore, if the warhead is traveling too slowly, it becomes an easier target for countermeasures. Fortunately refinements are possible and are being made, but the fact remains, Allen's blunt nose concept will continue to be used.

One propulsion device considered attractive for space flight is the so-called ion jet. Ions are tiny bits of matter, carrying electrical charges. They are formed when an electron is added to or removed from an electrically neutral atom or molecule. Neon lights, named after their inventor, Claude Neon, make use of ionized gases. These ions constitute most of the weight of the atom, and if they can be accelerated to high velocities, their energy can give useful thrust for gradual acceleration of the



An induction furnace is operated by Lewis research scientists as part of a continuing study of the properties of materials suitable for use in design of nuclear powerplants, and in the nose sections of hypersonic missiles. The induction furnace is capable of reaching 5,000 degrees F. temperatures.

An NACA aeronautical research scientist visually checks an experimental aircraft model in a small supersonic wind tunnel at Lewis. The model can be studied in an air stream up to three-and-a-half times the speed of sound.

orbit of a satellite vehicle or space craft.

Since 1952, the NACA has been studying how to get a man into nearby space in controlled flight. One of the 28 technical groups within the organization of the NACA is the Committee on Aerodynamics. In January, 1952, it spent a large part of its regular meeting in consideration of a presentation by the late Robert J. Woods of Bell Aircraft Corporation entitled, *Establishment of a study group on space flight and associated problems.*

In his paper Mr. Woods (who played a major role in the original X-1 project) called for basic research "in the mechanics and problems of space flight," and noted that the NACA is "the logical organization to carry on the basic studies in space flight control and stability as it is a logical extension of work now being done by the NACA." He also recommended that the NACA should "establish a concept of a suitable manned test vehicle" and called for design and construction of such an airplane as rapidly as possible.

The main committee of the NACA a short time later formally initiated studies "of problems associated with unmanned and manned flight at altitudes from 50 miles up and at speeds from Mach 10 (6,600 m. p. h.) to the velocity of escape from the earth's gravity (25,000 m. p. h.)." This action, it should be remembered, was months before man had yet managed to fly twice the speed of sound (1,320 m. p. h.)!

By the summer of 1954, the NACA studies had produced sufficient information for the agency to present to the Air Force and the Navy Bureau of Aeronautics a proposal for design and construction of an airplane capable of extremely high speeds and altitudes, thus permitting exploration into nearby space. Before the end of that year, a memorandum of understanding was signed by the Air Force, Navy, and NACA establishing the procedures to be followed in acquiring and using the desired rocket plane.

The memorandum provided that the technical direction of the project would be the responsibility of the director of the NACA, acting with the advice and assistance of a research airplane committee, composed of one representative each from the Air Force, the Navy, and the NACA. Administration of the design and construction phases of the project was assigned to the Air Force. The memorandum was concluded by the statement: "Accomplishment of this project is a matter of national urgency."

A design competition was conducted, and in the fall of 1955 the go-ahead signal was given to North American Aviation, Inc., to build three X-15 airplanes. The Air Force has provided the bulk of the funds for the design, construction, and support of the airplane. It has responsibility for development and procurement of the pilot's personal equipment, and for providing flight and engine (built by Reaction Motors, Inc.) test facilities. It also has provided the B-52 mother airplane and is modifying it for the program. The Air Force has provided the technical advice required during construction of such a vehicle, drawing upon the various laboratories at the Wright Air Development Center as well as the experience of its Flight Test Center at Edwards AFB. The Navy has assisted in financing the project as well as furnishing test facilities to simulate flight conditions which pilots may experience.

The NACA has conducted extensive wind-tunnel studies ranging from simulated landing speeds to the ultimate performance of the airplane. These have in-

Aft view of a 16-inch ramjet in test position, seen through the floor opening of the Lewis Unitary Plan Wind Tunnel. The body of revolution downstream of the ramjet nozzle is a movable plug, used to simulate the changes in internal flow that would take place during engine combustion.

cluded tests for aerodynamic, heating, and control characteristics.

Following completion of the relatively conservative performance-guarantee flights by North American pilots, the X-15 will be flown by pilots of the Air Force and the NACA. The Air Force officers will seek to determine maximum performance characteristics of the airplane, while the engineer-pilots of the NACA will be conducting detailed flight-research investigations of numerous problems over the entire speed and altitude range.

Little can be said about ultimate performance of the X-15 when it is flown on the first ventures by man into nearby space. The most specific official statement to date has been by the Secretary of the Air Force, James H. Douglas, who said the X-15 "should permit man to fly at speeds greater than one mile each second (3,600 m. p. h.) and at altitudes above 100 miles . . . The X-15 is a step toward a manned satellite."

Since the end of World War II the NACA has accomplished much by way of solving problems of flight beyond the atmosphere. At the Ames and Langley Aeronautical Laboratories, work of very great value has been accomplished with respect to the boost-glide vehicle. In this concept, the vehicle would be propelled by a rocket to high altitude, but not so high that it would lose the lift which is produced when a properly shaped craft speeds through the atmosphere. Its speed would be so great—perhaps as much as 12,000 m. p. h.—that it could glide without additional power to almost any point on the earth. Security prevents detailed discussion of the problems involved. They are very difficult and complex. Even so, the boost-glide concept is sufficiently attractive to warrant determined effort to find acceptable solutions.

Even today, not all the NACA research effort is concentrated upon missile and space flight problems. For years to come it is likely that the Air Force and the Navy will require high-performance aircraft. Right now, one of the most urgent of Air Force requirements is a long-range bomber that will fly nonstop over roughly the same distance as a B-52, and make that flight at a speed very much greater than the best the B-52 can manage.

Recently, North American Aviation, Inc., was declared the winner of the competition. The airplane—the WS-110-A which has just been designated the B-70—will fly its entire mission at supersonic speed. It will incorporate the latest in aeronautical advances—aerodynamic, structural, and propulsion—from the NACA laboratories in Virginia, Ohio, and California.

One big reason for the confidence in this new NACA supersonic information is that it has been proven right in the past. In February the Air Force announced its B-58 medium-range bomber, the Convair *Hustler*, had flown supersonic continuously for an hour and a half. This airplane makes use of a great many NACA innovations. To name only three: (1) Its wing has NACA-developed camber, a sort of droop, that for very technical reasons greatly improves flight efficiency; (2) it incorporates the NACA area-rule concept, shaping fuselage and wing to obtain much better efficiency at supersonic speed, and (3) the B-58 powerplant installations and the engines themselves, reflect advanced NACA research data. The B-58 has demonstrated spectacularly that the supersonic data that the NACA has proved with models installed in its wind tunnels and fired by rockets from its field station at Wallops Island, off the Virginia coast, are if anything, conservative.

NACA work on the WS-110-A program has been on a crash basis for nearly a year now . . . and it is likely to continue that way until the airplane takes to the air a couple of years from now.

Not long ago, Secretary of Defense Neil H. McElroy, in looking ahead to the work to be done to advance the space technology programs of the United States, commented about the effective manner in which the military services and the NACA have worked together in past years:

"We have carried our share of the load, they have carried a strictly scientific share, and I think that we have contributed to each other's programs in a way which I think is most desirable for this kind of thing to proceed."

This kind of cooperation has been an essential element in America's winning world supremacy in aviation. It will be required no less in the days ahead as we send man farther into space.

Five-stage rocket: Three to fire it up and two to fire it down to test high re-entry speeds.

According to Greek legend, Bellerophon tried to ride to heaven on the winged horse, Pegasus, after slaying the hybrid she-monster. The constellation of Pegasus is located near the vernal equinoctial point.

Stepping Stones In Space Geography

by T/Sgt. John K. O'Doherty

WHEN the first manmade earth satellite soared into orbit on October 4, 1957, the world in general was startled into a re-awakened awareness of space, of the marvels of the universe, and the stupendous implications of such newfound scientific knowledge. Overnight, the everyday conversation of ordinary citizens became punctuated with scientific terminology which previously had been confined to the student in his classroom and the scientist in his laboratory.

There is nothing new about man's interest in space and the heavenly bodies which move on their appointed courses through the limitless void beyond the earth. Written history had its beginning about 3,000 years before the birth of Christ, and by that time man had already accumulated a considerable store of knowledge on the subject. The Egyptians of the Nile Valley and the Sumerians on the lower Euphrates made use of the stars to help them in surveying and building, and the Egyptians devised the 365-day calendar based on the sun while Europe was still a forest inhabited by barbarians.

The ancient Greeks made their debut in history about 1200 B.C., and this refined civilization made tremendous strides in deciphering the phenomena of the universe. Some of their conclusions were somewhat wide of the mark, but a great part of the modern spaceman's vocabulary is inherited from the Greeks. Such words as planet, astron, sphere, apogee, perigee, and dozens of others are a part of this bequest.

The Chaldeans of Mesopotamia, a cultured people who flourished in the period of the second Babylonian empire, 600-500 B.C., knew how to predict eclipses of the sun and the moon, and there are indications that they were aware of the existence of the planets Jupiter, Mars, Venus, Mercury, and Saturn. Like the Greeks and the Egyptians, the Chaldeans

developed some rather remarkable theories to explain the mysteries of the universe.

Elephants and Turtles

The Chaldeans, for example, believed that the earth was contained in a sort of enclosed chamber, with the sidewalls arising from the sea and the arched dome of the sky forming the roof. The Greeks thought that the earth was a flat disc surrounded by the ocean. One of the most picturesque theories of all was propounded by the Egyptians. They believed that the earth was a flat plane resting on the backs of four elephants which stood in turn on the shell of a gigantic tortoise, swimming endlessly in a great ocean.

The influence of these earlier civilizations is reflected in the names given to the planets and many other heavenly bodies. The rich mythology of Greece and Rome is immortalized forever in the stars. Jupiter, Mars, Venus, Mercury, and Saturn were all prominent members of the great family of gods, and modern scholars respected the tradition in selecting designations for more recent discoveries. The constellation Andromeda, the "Lady in Chains," is named for an Ethiopian princess who was chained to a cliff and left to be devoured by a monster. She was rescued by Perseus, who is also immortalized in a constellation bearing his name.

In the second century of the Christian era, Claudius Ptolemy, an Egyptian living in Alexandria, published a remarkable work in which he explained the mysteries of the universe. According to Ptolemy, the earth was the center of the entire system with the sun, the planets, and the stars revolving around it. Ptolemy was a compiler of existing information rather than an original thinker. He extended and systematized the ideas of his predecessors, especially the earlier Greek scholars Apollonius and Hipparches. His work made a decided impact on the world of that time, and his teachings were accepted by students everywhere for about 1,300 years. Arab scholars called his text the "Almagest," from the Arabic words meaning "the greatest."

Down through the Middle Ages nobody bothered to dispute the doctrines of Ptolemy until the Renaissance brought a revival of learning to Europe in the 16th century. In 1543, Nikolaus Copernicus, a Polish scholar, published his book, *On the Revolutions of the Heavenly Bodies*, in which he attacked the time-honored fallacies of Ptolemy. Copernicus explained the rotation of the earth and its revolution around the sun. He described the movements of the planets and recognized the existence of immense space beyond the solar system. The teachings of Copernicus paved the way for the progress which followed, and the invention of the telescope in the 17th century enabled other students to confirm his theories. In 1610 Galileo found the four large satellites of the planet Jupiter, the first celestial bodies to be discovered by telescope. Johannes Kepler evolved the laws governing planetary motion, and Newton's explanation of gravity and the laws of motion facilitated further study. In 1844, Auguste Comte, a French philosopher, announced that there was nothing more to be learned about space beyond the earth; man's store of knowledge on the subject was complete.

The invention of the camera and the spectroscope quickly discredited Comte as man's curiosity led him relentlessly forward. Every civilized country contributed to the crusade for greater understanding of the universe.

The moon, being the nearest of the heavenly bodies to earth, has always excited particular interest among students of the universe. In the late 19th century, Professor George H. Darwin proferred an interesting theory on the origin of the moon. He said that at one time in its history, the earth was a molten mass, and its spinning motion formed it into the shape of a pear. At the same time the crust of the earth heaved and split as metal and gas seethed and boiled on all parts of the surface. In one such convulsion, the point of the pear was broken off to hurtle into space and into orbit as a permanent earth satellite.

If such a thing did happen, it would have left a hole in the earth's surface 27 miles deep, and Professor Darwin suggested that this hole might now be the bed of the Pacific Ocean. There is at least one geological circumstance to support this possibility. Over the greater part of the earth's surface, the outer crust contains considerable acid-type rock, such as granite. Petrologists find that the Pacific area is distinguished by the absence of such matter. Could it be that it was torn away and now forms the substance of the moon?

Parade of Planets

Nothing could be more dependable than the orderly progress of the heavenly bodies as they move on their appointed paths in space, and one of the most fascinating stories in the history of space study concerns the time that the planet Uranus was lost from its orbit. Uranus was well known to skywatchers for centuries. The Chaldeans and Assyrians were familiar with it, and regarded it as just another star.

In 1781, William Herschel, a church organist of Bath, England, established definitely after prolonged observation that Uranus was a planet—revolving around the sun as a member of our own solar system.

Uranus' journey around the sun requires 84 earth-years, and for 40 years after Herschel's discovery scientists around the world followed its progress with interest. Then one day in 1821 a French scientist, keeping his charts of the planets, was startled to discover that Uranus was not where it was supposed to be. The deviation wasn't much from the viewpoint of a layman, but in the world of science such a thing was absolutely unheard of. Scholars everywhere scratched their heads in wonder.

The unorthodox behavior of Uranus with a 40-year reputation for respectable dependability in the solar family proved to be no accident or error in mathematics. Uranus was out of her orbit by 20 seconds in 1830 and by 90 seconds in 1840. By the time 1846 came around, Uranus was late by 128 seconds. This was the greatest mystery in the history of modern science, and discussion among the sages of the time was as animated and heated as the dignity of scholarship would permit.

Two mathematicians—Urbain Leverrier of France and Professor J. C. Adams of England—finally solved the mystery simultaneously. They decided that Uranus was being pulled out of its orbit by some powerful force of which they had no knowledge. After making the necessary mathematical calculations, Leverrier sent a message to Dr. Galle at the observatory of Berlin on September 18, 1846, asking him to train his powerful telescope at a certain point in the heavens at a certain time. Here, wrote Leverrier, would be found a planet which no man had ever seen. On September 23, Dr. Galle aimed his telescope at the designated spot, and sure enough, found a bright light which did not appear on any of his charts. This is how Neptune was discovered; the eighth planet of the solar system and the source of the force which disturbed Uranus from a distance of 100 million miles.

The ninth member of the sun's family was discovered in a similar manner when scientists noted irregularities in the motion of Neptune around the sun. The Lowell Observatory at Flagstaff, Arizona, finally sighted the culprit after a search that lasted for 25 years. On January 21, 1930, Clyde W. Tombaugh made a photograph which proved the existence of Pluto, 3,680,000,000 miles from the sun.

The discovery of Pluto seems far in the past when viewed in the light of human accomplishment during the past decade. The horizons of space loom ever broader in the future as man pursues his destiny in the quest for ultimate truth and understanding.

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MILKY WAY STUDY IN CONTRAST, 951 A.D.: The Horsehead Nebula thrusts its head and neck above a dark cloud bank of gas and dust which makes nearer stars stand out but veils those beyond it. Above is an open celestial field with several stars of surpassing brilliance. The fiery splotch of light in the lower left corner is caused by an extremely hot star, some of which have surface temperatures as staggering to the mind as 180,000 degrees F. Our sun, a medium-sized star, is not so hot with a mere 10,000-degree reading. Astronomers have computed that the light which yielded this space panorama in 1951 had been 10 centuries in transit to Palomar, so this is an exterior vista as it looked in 951 A.D., or 541 years before Columbus discovered America.

The Wide New Yonder

WHAT IS OUTER SPACE? IS DEEP PENETRATION LIKELY SOON? A HARD LOOK AT THE MYSTERIOUS REALM BECKONING MAN.

by William A. Kinney

STARS are the mile markers of space. About 9,000 of them are visible to the naked eye around the globe, although the count for any one locality is much smaller.

When I stood alongside the mortarlike barrel of the Big Schmidt telescope that first night of the Sky Survey's "dry run" in early June of 1949, my eyes could pick out only a handful of tiny pinpricks of light which the stars made in the black oblong of night framed in the open panel of the observatory dome.

Seconds later when I sighted through the eyepiece of the mighty instrument, the blackness abruptly dissolved into a swathe of brilliance and I beheld not a handful of stars, but a host, all touched with a strange new light, some amid drifting iridescent clouds. Space, this small segment of it, was unbelievably more populous than I had dreamed.

The Big Schmidt, from its location near the crest of 6,100-foot Palomar Mountain, could reach three-fourths of the heavens for photomapping in the Sky Survey, completed only two years ago. Our fondest hope, before the official "kick off" the following month, was the Survey would establish that our earth had something more than 10 times as much space beyond it than man then knew with any certainty. Actually, the Schmidt surprised all with pictorial proof that there was at least 25 times more exterior space within its range than anyone previously expected.

And the Schmidt's Palomar teammate, the 200-inch Hale telescope,

has used the survey's plates since for studying narrow fields of much, much deeper space too distant for the Schmidt's "vision."

Anyone who was associated with the Palomar project can not help being acutely aware that the nomenclature applicable to cosmic space, its celestial bodies, and phenomena is far from a haphazard assortment of words to be used as if they were almost interchangeable.

What, however, has been happening since man's first satellites made the world space-conscious?

Occasionally the expression is employed with judicious discrimination by careful speakers or writers who first stake off what segment of "outer space" they have in mind, so that all subsequent mentions have a fairly well defined point of reference. In these cases, the use of "space" is much the same as speaking of a "car" after making clear at the outset this means an automobile, not a trolley, or kiddie car.

The widespread general practice, however, is to bandy about the whole inventory of space terminology without regard to the staggering amount of territory the various expressions cover.

It is not surprising, therefore, that more than a few in USAF blue have become increasingly confused as to what the terms are really supposed to mean.

That such confusion exists and how widespread it is, I know from numerous talks during the past several months with airmen, both of enlisted and commissioned grades. All have manifested intense interest in the mysterious new horizons now beckoning, and are earnest about getting squared away on the score. Yet even those who have had the opportunity to start systematic reading confess to different degrees of uncertainty or vagueness. The same general note has been common in the countless conversations one could not avoid overhearing.

Compounding the confusion, in the belief of others besides my own, has been the slipshod use of such expressions as interplanetary, interstellar, intergalactic, and on down. With disturbing frequency they crop up in contexts which tend to leave the impression they are all synonymous terms or that there is not a great deal of difference between them.

Last month a master sergeant called my attention to a magazine ad for a manufacturer of aircraft components adaptable for future space planes. Its illustration showed the solar system, with a big area marked by shading. The caption, in big type below, proclaimed the equivalent of *milk run zone*. The copy did not mention that a round-trip mission from earth to the edge of the shaded zone would involve a mere 780 million miles of beeline flight. Nor did the copy say the shaded area *was* the *milk run zone*, but the implication was left with the reader.

Another recent exhibit was the announcement of a new book on space travel, with a title so worded it took in the entire solar system. The author is a scientist of international repute. Ironically, even civilian specialists connected with the rocket and satellite programs, men from groups who should know better, have repeatedly been guilty of using space terminology in a high-wide-and-handsome, but imprecise, fashion. If the experts talk like this, is it any wonder a nonexpert airman gets perplexed?

Things have come to such a pass that stories are cropping up in information media that the U.S. may be nearing a breakthrough on a propulsion system capable of delivering velocities equal to and surpassing the speed of light—which is only about *186,000 miles per second!* According to Einstein's Theory of Relativity, which has stood up pretty well so far, it is impossible for anything in nature to exceed light's speed, yet the gullible take it as gospel that we are about to do it. Such stories usually omit any parenthetical reference to Einstein or call attention to the fact that our first satellite, the *Explorer*, is orbiting at the tortoiselike speed of a little more than ¾ mile per second.

Statistics are nonexistent on the percentage of USAF personnel with previous formal education, training, or varying exposure to matters astronomical, but I suspect the percentage would prove rather modest. It is for the larger number, then, that this article seeks to make at least a small contribution toward bringing some fundamental facts about space into true focus.

Space (to drop the not-too-meaningful "outer") is an amazingly elastic word, subject to rapidly changing definition. By way of an inadequate analogy, recall the early days of our nation. "The West" meant the country just beyond the first mountain ranges inland from the coastal colonies. In George Washington's dream, the opening of "The West" was to push through a canal to the rivers giving access to eastern Ohio, and the old Northwest Territory beyond. Then "The West" shifted across the Mississippi onto the Great Plains, next it moved across the Rockies into the Great Basin, and finally over the Sierras and Cascades to the shores of the Pacific.

We wound up with so much "West," we had to partition it—Far West, Pacific Northwest (since the old Northwest lay east of the Mississippi), Southwest, and Midwest (which, by some definitions, begins east of the same parallels of longitude that pass through several states on the Atlantic seaboard).

If this seems mildly mixed-up, consider how the initials, ICBM, today trigger most people to start thinking of "intercontinental" distances in terms of the 5,500-mile range. But, just a minute. It takes less than the regulation 30-inch pace to move the intercontinental distance between landlinked continents like North and South America, Asia and Africa, and Asia and Europe. Only a mile or so of water separates North America and Asia in the Bering Strait where the International Date Line passes between Alaska's Little Diomede Island and Siberia's Big Diomede.

Trying to propound a "tight" definition of space is like that; it poses perplexities similar, in essence, to those inherent in the slippery question of whether our "West" began where it was originally believed and why it became so fluid, or what is the correct criterion for computing distance when its bracket is "intercontinental." Only with space, the task is subject to an awful amount of redoubling. Even so, there is no lack of key facts which can be taped to help any airman get his bearings. (*more*)

Prehistoric-born Light

At Palomar, the guidescope I used had relatively small penetrating powers compared with the powerful optical system of the 48-inch lensed Schmidt. The sight would be trained on an easily visible star in the area to be photomapped and then hold that star in the sight's crosshairs while the Schmidt's high fidelity camera went to work.

The objective of the survey was to produce a Sky Atlas which would increase man's knowledge of the celestial bodies and other phenomena in the Milky Way, the galaxy of which the solar system containing the earth is a part. In addition, it was hoped the Schmidt could produce a limited pictorial census on some of the exterior universe just beyond the limits of the Milky Way.

Optimistic advance estimates gave the "Big S" a maximum range for clear, high definition photography of about 300 million light-years. A light-year is the distance a beam of light traverses in a dozen months, to be exact, 5.8 million million miles —or 5,880,000,000,000 written in numbers. Astronomy uses this basic unit because space has distances so stupendous they have to be measured "wholesale." The idea is much the same as reckoning weights in terms of tons instead of ounces.

It was also the conservative advance estimate that four years would see the program completed, with the portrait of the surrounding heavens in the emulsion of about 1,800 photographic plates—a portrait the size of a tennis court.

But the "Big S" astounded the astronomical world with its capabilities. It soon demonstrated its unusual optical system could "see" more than three times the estimated maximum range out into the unmeasured far stretches of the universe and capture photographs of heavenly bodies in environments as distant as *a billion light-years.* That number of light-years extended the known frontier of the universe by 4,000 billion billion miles, or by 4,000,000,000,000,000,000,000 miles to give it in numbers.

Did someone mention anything about travel to "outer space?"

It may be incomprehensible for most imaginations, but the Schmidt has photographed celestial bodies so faintly luminous that the beams of light which carried their images to the camera plates had been in transit earthward for multithousands of centuries before the first primitive man walked our planet in the old stone age a mere million years ago.

ON TARGET! Resembling a bulky siege gun but the most powerful instrument for total capabilities in astronomy's inventory, the Big Schmidt trains on a sector of the heavens to be photomapped for the National Geographic Society-Palomar Sky Survey. At the eyepiece is the late Dr. Edwin J. Hubble, the century's No. 1 astronomical genius to date. In his hands is the "guiding head," with push-buttons, to rectify immediately any minor drift from the photo-telescope's original aiming point. So sensitive is the Schmidt's optical system, it can pick up the flickering flame of a candle 10,000 miles away from our globe.

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Peering through the guidesight at any mapping area, an observer doesn't suspect how many heavenly bodies it encompasses, even when the concentration visible appears large. It was always an amazing experience for me to study the 14- by 14-inch survey plates after they had been developed. In target perimeters where the guidescope had found celestial vistas of especial beauty and radiance, the plates would reveal incomparably grander panoramas. Had I not been able to pick out the guide stars in many such instances, I would have been convinced I had sighted elsewhere. Each plate, incidentally, provided coverage of sectors of the heavens which measure 26,000 miles across, or a dozen times the diameter of the moon.

The story of the Schmidt's colossal achievements in exploring the heavens has another installment—the discovery of other galaxies beyond our Milky Way system, separate island universes as large and many times larger than our own—but that must await telling for otherwise it would complicate efforts to bring the various regions of space into some sort of perspective.

Talking to one of the nation's most eminent scientists only a month ago on this question of perspective, I referred to the erroneous use and abuse of space terminology with very specific definitions. He thought it deplorable. As I ticked off the list, the one that appalled him most was: *Intergalactic Travel and Pioneering.*

"Kinney," said he sadly, "anyone talking about that being in sight must be out of his mind. How does he think we are going to get out there? Has he any idea of the mileage or length of time such missions would take? Even in our wildest dreams we can't possibly forsee the day when manned vehicles will be threading out among exterior galaxies and returning safely.

"A century hence?" His voice was dubious. "There is much, oh so much work to be done closer in before we'll want to take on the galaxies—if or when we are ready for them."

The Big (?) Wheel

"Closer in." Questing man has been curious about the visible skies since he began studying eclipses and other heavenly phenomena over 21 centuries ago, but he has always been poorly situated for learning what he would like to know.

Astronomers spell out the handicap by likening our Milky Way galaxy to a sandwich. The earth is a dime-sized piece of meat between two thick slices of bread large enough to cover a basketball court. On the scrap of meat man is a submicroscopic ant who has been trying to get an idea of the bread's composition and dimensions but can't see far into or through the two slices.

Only by getting man outside that celestial sandwich, they say, can he determine what it looks like. So we'll proceed to arrange his escape right now.

Modern technology is still in its stone age phase of evolution when compared with the inventiveness of the human imagination in programming vehicles and ultra-exotic propellants to send intrepid creatures of its fashioning up beyond the bonds of earth. The know-how stretches all the way back to the second century A.D. when a Greek writer conjured up a hero who made not one, but two trips to the moon, so the reentry problem was licked long ago. This fancied traffic through the heavens hasn't stopped since.

For the extragalactic mission at hand, the reconnaissance spacecraft—XRSC-1—is more revolutionary in design than any of its predecessors. Its cabin is crammed full of instruments and other equipment with capabilities which exceed the wildest dreams of plodding science. The observer has been briefed. The launch is flawless. The flight is on.

As the XRSC-1 emerges into the space gulf outside the Milky Way (flight time deleted) later, the observer sees he has just left a luminous white, cloudy formation of considerable size. His immediate interest, however, is his native planet and he cuts in a precalibrated telescopic vision screen to make notes on its appearance.

The image comes in with high clarity, about the size of a standard classroom globe. Gazing at it, the observer decides one would never suspect that this was a sphere nearly 8,000 miles in diameter, supporting a teeming population of close to 3 billion people.

Next on the checklist is the celestial geography of the solar system in which the earth courses. To study this the observer turns to a larger vision screen. The yellow ball of the sun dominates the picture and it takes a few moments before he picks out the earth orbiting. His first reaction is surprise at how much it has shrunken, until he remembers the sun is more than 100 times the earth's diameter. The moon, with a midsection about three-fourths smaller than the earth, shows up the size of a buckshot pellet.

While the observer cons the screen to follow the nine major planets swinging along their eccentric ellipses, a card slides down the slot of the panel's computer. A glance at it tells him that the earth and five other major planets revolve about the sun in an inner belt of no great breadth on the screen but actually having a maximum radius of some 935 million miles from Old Sol's surface.

The other three planets move widely separated in a much broader second belt whose maximum radius from the sun is 4.6 billion miles, the farthest point in the last ellipse which is Pluto's.

The immense radial distances of planetary orbits has the observer wondering how he can put them in a frame of reference for his report. Plainly he can't cite figures for the U. S. satellite, *Vanguard*, which represented man's "deepest" penetration of space when the reconship was launched for its present mission. The maximum altitude the *Vanguard* reached above the earth was 2,513 miles and the minimum altitude in its ellipse brought the radius down to 407 miles.

Finding a frame of reference will have to wait; the reconnaissance mission still has much high priority work to do. The checklist directed the observer to develop a general intelligence summary on the star deployment throughout the Milky Way, with relation to distances from the earth's solar system and any data pertinent to stellar exploration. Only the extraordinary capabilities of his vehicle enables the observer to cover the unmeasured amount of territory that is involved and to do it in negligible time.

The first notation for his summary is that he could observe a band of stars along the rim of the Milky Way, but that the greatest concentration—burning with intense brightness—is massed around the central area of the galactic axis. He adds further that the real titans of the galaxy were to be found among its stars, for his instrument battery kept reeling off data on individual stars several hundred times bigger than the largest body in the solar system, the sun, itself a yellow star—and only a medium size yellow star, at that.

The recap on distances discloses that the sun is the nearest star to the earth: the interval varies between 91 and 94 million miles. But that maroons the sun out in the middle of nowhere like a castaway from the rest of the adult star family. The earth's next closest stellar neighbors are in the constellation Centarus, 4.3 light-years or over 2,500 billion miles away. As if to underscore the isolation of Old Sol, the tabulator count on other star-suns within the galaxy now totals in excess of 100 billion.

Our observer has long since abandoned hope of describing the pageant of dazzling light that the star fields offer, or the interplay of colors from an intense blue to a smouldering red. He fills in the form for the surface temperatures of the five major categories by averaging the readings on a bank of supersensitive thermo-spectographic instruments. At the top of the scale are the blue or blue-white stars whose temperatures soar as high as 180,000 degrees F.; at the other end are the red stars, where it drops as low as 3,600 degrees on the surface. Our sun, which man since primordial times has considered the mightiest fiery furnace in the universe around him, doesn't live up to that reputation by running a temperature of only 10,000 degrees. White stars are in the 18,000-degree class while yellowish-white ones average about 13,000 degrees.

Now comes the most difficult task entrusted the reconnaissance mis-

sion: report approximate size and configuration of galaxy. That required some consummate skill at the XRSC-1's controls. There are no beelines, no vertical climbs in space flight, once a vehicle is orbiting. To shift from one ellipse to another, a pilot must calculate to a nicety the amount of thrust to be applied gradually to ease his craft toward a higher altitude, yet still maintain the delicate equilibrium between the vehicle's momentum and the strength of the gravitational field in which it is moving. The momentum produces a centrifugal force just right to counterbalance the gravitational attraction of the body or galactic system involved. This explains the free flight phenomenon of the *Explorer* and other satellites around the earth.

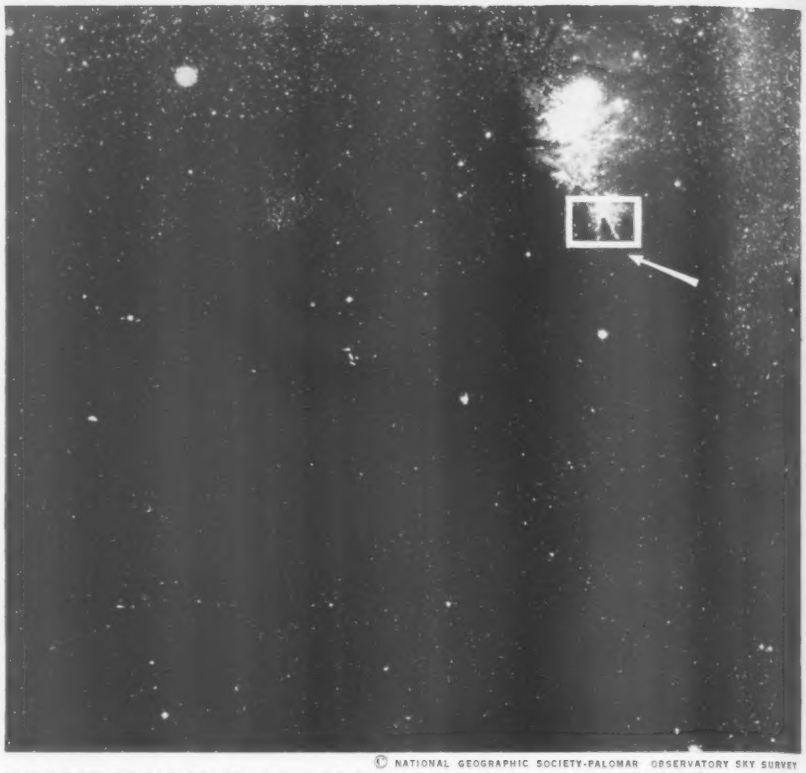
A last short thrust nudges the observer's craft into the desired new ellipse and he has the whole Milky Way in view.

It has the appearance of a big wheel, with rounded, streamlined projections at its hub on either side. Its shimmering white is heightened by the void of nothingness in which it is suspended.

The automatic computers feed out more preliminary data. Diameter: from 80,000 to 100,000 light-years. Knowing that a 10 percent error may occur in astronomical calculations of this magnitude, the observer jots down 90,000 and accepts an estimate of 10,000 light-years for the galaxy's maximum thickness.

The luminous wheel is rotating. The computers produce a total of more than 200 million years by man's calendar for a given point on the rim to complete a single revolution. Compare this with the 250 years it takes Pluto, outermost planet in our solar system, to make a full circuit around the sun.

The observer turns on his largest vision screen, whose system is equipped with special magnifying and filtering devices. He has to look hard before he locates our solar system in an area about two-thirds the distance from the galactic hub to the rim. Using the 90,000 light-year diameter base, this means a manned mission from earth would have to travel 15,000 light-years to cross the galaxy's nearest frontier.



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THE LOOK OF FAR SPACE. Celestial light sped through space at an 186,000-mile-per-second clip for 600 million years before reaching the Big Schmidt's camera to produce the remotest images in the star-strewn square of the heavens copied from a quarter of a Sky Survey plate (opposite page). The wide-angle Big Schmidt acts as an astronomical "bird dog" for Palomar's "Big Eye," another telescopic camera designed for pinpoint study of narrow-angle areas at

But how insignificant the solar system becomes when studied in its galactic setting. As a component, its size is the order of 1/100,000,000 of the whole. And in that big picture, the observer sees his earth has dwindled to the proportions of a minute grain of sand.

A grain of sand lost in this great wheel of multibillion stars, innumerable huge clouds of iridescent gases, whirling cosmic dust and debris—a tiny dot swimming in the inner space of its own galaxy.

Inter-what, Little Man?

Good intelligence procedure requires a thorough debriefing after any extensive reconnaissance successful in developing information which bears even remotely on all conceivable future theatres of operation.

The mission has been a solemn experience for our observer and his demeanor is grave but the debriefing soon demonstrates he is a superb reporter. Understandably, he requires several sessions to complete his oral presentation. His own notes are voluminous. Moreover the array of automatic devices carried by the recon-craft had recorded an intimidating amount of unprocessed data, all of which had to be fed into a battalion of electronic brains to ruminate over, analyze, and produce definitized evaluations.

Throughout the debriefing maximum security regulations were rigidly enforced. The number participating in the sessions was limited, with few civilians, mostly scientists. Admittance was restricted to only those already cleared for access to classified material in the newly instituted supreme category: *Top Spacious.* While the lengthy transcript of the observer's verbal report, along with his finalized written supplement, bears that classification, some illuminating portions of his commentary have been sanitized and it is now possible to disclose some highlights very relevant to the subject matter with which this article is concerned.

Of particular interest are the fixes the observer had been able to take

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distances double the Schmidt's maximum range. The detail the "Big Eye" found in the tiny target outlined in the Sky Survey picture is dramatically evident in the above closeup of what is now called the Cone Nebula. The blazing star near the top of the photograph illuminates the eerie-shaped cloud of gases or dust, making it look like a dog with upraised forepaws, a groping ghost, or even a mysterious "abominable spaceman."

on other galaxies across the empty gulf immediately surrounding the Milky Way. Made while he was gradually reducing his vehicle's ellipse for reentry, these indicate that the nearest island universes to our own system are two dwarf galaxies, a type containing only a few million stars instead of billions.

By the observer's calculations, the smaller of the pair has an estimated diameter of only 1,500 light-years, which is approximately one-sixth that of the Milky Way.

The dwarfs are located only a short distance in light-years from the first fair-sized exterior galaxy the observer spots. This is Andromeda, a luminous wheel formation like our own system, although a third smaller. He gave the mileage to Andromeda as 9 quintillion.

At this juncture, the observer took great pains to point out that these three "island universes," like the many others outside our own, are all covered by man's blanket description, extragalactic world or extragalactic systems, the point of reference for that "extra" being our own galaxy.

The word, he stressed, was a general term. Used without the proper modifier, it takes in nebulae of all sizes, shapes, and peculiarities, from gigantic galaxies dwarfing our own, to the much smaller economy-sized nebulae found throughout our own galaxy, as well as in others.

"Gentlemen," he went on, "consider a generic term we hear so often today—propellant. Would anyone here give me a requisition for a 'propellant' without further specifications? If that happened, I could fill the order with anything from a slingshot or longbow to a canoe paddle or the most exotic fuel. All are means of propulsion. Even a good shovel is a 'propellant.'"

Then he teed off about the need for a start of study looking to the compilation of a clearly defined, specific nomenclature on space for future use, and also for an immediate campaign to shake out the loose, unqualified terms now in circulation.

"Technically, sirs, I was in extragalactic space as soon as my vehicle emerged from the Milky Way," he asserted. "However, considering how much of that space there is beyond, I was like a small boy claiming he was 'at sea' the minute the keel of his rowboat slid free of a beach at the widest stretch of the Pacific."

The observer dismissed as nonsensical all speculation of interstellar missions in the Milky Way during the present generation. He cited the intimidating one-way mileages of 2½ billions upward. He also inquired how, in the foreseeable progress of the art, man could expect the development of rocketcraft which would not be incinerated by the tremendously high temperatures of the stars and the gases around them.

As for interplanetary flight, that meant an operational ballpark going out 4.6 billion miles to Pluto. Reconnaissance of the nearer planets probably would be possible some decades hence, he said, and he advocated terminology to fit that neighborhood league.

"Otherwise," he continued, "'interplanetary' will be the equivalent of putting a commuter's 30-minute ride to a city in the same travel category as a four-day trip from Los Angeles to New York because both are literally on interurban trains since they link two urban destinations."

He refrained from insulting his audience's intelligence by ignoring harebrained conjecture about missions to other extragalactic worlds. He contented himself with a passing reference that even intragalactic flight throughout the Milky Way's expanses depended on man's ability to come up eventually with some propellant imparting velocities far above the minimum of some 25,000 m. p. h. estimated necessary for putting a satellite into lunar space.

"When you stop to think of it, gentlemen," he summed up, "it is obvious that the main operational area for manned spacecraft, when they are ready, will be logically and for a long time the circumplanetary zone of the earth's thinning upper atmosphere."

"So why not talk of it that way, like calling a spade a spade, instead of terming it an 'excavator,' which also is good for describing the biggest steamshovel?" (*more*)

At this juncture one in the back of the briefing room was heard to whisper to his neighbor it was strange he had never heard the expression, circumplanetary space, used before, and that it did not sound like a couple of dirty words, come to think of it.

Beyond the Beyond

The debriefing on the reconnaissance gives a general rundown on the nature of space "closer in," but barely hints at what is farther out. The three island universes reported by the observer may seem unbelievably distant from the Milky Way. The fact is, however, they are so comparatively near that astronomers speak of them as our "local" galaxies.

Besides securing the portrait of the Milky Way, the Schmidt charted myriads of other island universes continuing onward, yet onward by the thousands as if this mysterious galactic archipelago extended indefinitely into the eerie loneliness beyond.

Hitherto unknown galactic systems were photographed out to a distance of a billion light-years—the maximum range for obtaining images of hard clarity definition with the Schmidt's optical power. The rays which produced the images of the most remote objects had to travel the mind-numbing equivalent of 600,000 centuries to reach the emulsion on the telescope's plates.

On some plates up to 50,000 giant galaxies have been counted, each composed of hundreds of millions or billions of stars. These are all complete systems, each as well defined and distinct from the next as they are from the Milky Way—a puny galaxy in comparison with most of these other cosmic entities.

There is one vital statistic about this tremendous extragalactic world that airmen can paste in their hats for future reference. The distance between any neighboring systems averages *2 million light-years*, with few exceptions. Anyone peddling the idea that intergalactic travel is just around the corner is advertising his own utter ignorance on the character of space.

Although the Schmidt's maximum range is a fantastically remote arc in the heavens, the 1-billion-light-years marker does not represent the end zone of the teeming celestial fields. An airman who misguidedly bought the idea that "deep space" missions would be part of his future may be suffering from flight fatigue at this moment, but he hasn't hit real "depth" yet.

On Palomar, the Schmidt has a mighty teammate — the 200-inch Hale telescope—a piece of astronomical ordnance so huge that it takes an observatory as tall as a 12-story building to house it.

Where the Big S "sees" wide and deep, the Hale "sees" deeper but narrower. Popularly known as the Big Eye, the Hale has more than double the Schmidt's range and thus can make high fidelity photographs of heavenly bodies and phenomena some 2 billion light-years distant.

The area covered by a single photograph is so small, however, that it is estimated that the Big Eye would probably require 10 centuries to map all the heavens the Schmidt covered in seven years, although the Hale coverage would obviously be of greater depth.

Here is how the team operates. Schmidt plates not only capture with clarity celestial scenes up to its maximum range, they also pick up dim and fuzzy images of objects on the other side of its "fence." These are given magnified study in the laboratory and the most unusual or mystifying images are turned over to the Big Eye to investigate.

Words are futile for conveying any graphic idea of how the Hale's magic can transform a few barely distinguishable specks I have seen on Schmidt plates into thronged panoramas so spectacular and dramatic that often a layman's mind finds it hard to conceive that such natural grandeur is real and exists. Only a comparison of Schmidt and Hale plates can begin to indicate the contrast, and even this is considerably lessened when the pictures are reduced in photoengraving for illustrations accompanying this article.

What has the Big Eye seen beyond the reliable limits of the Schmidt's sight?

A whole new uncounted array of island nebulae sweeping ever onward to the utmost bounds the Hale can reach.

I was extremely fortunate during the years of my association with the Sky Survey that its masterplanner and chief of staff was the late Dr. Edwin P. Hubble, acknowledged dean of American astronomy and the genius who led the way in the study of this increasingly remote, unmeasured expanse of galactic systems. An engaging, intensely human individual, who found relaxation in detective stories and (unscientific) science fiction, he was one of the kindly tutors who guided me through the kindergarten of astronomy and astrophysics into what I hope is at least the first grade.

One night on Palomar curiosity prompted me to ask him whether this sea of galactic islands could possibly continue indefinitely.

"We don't know yet," he replied, adding some tentative indications had been found that the number of galaxies begins to decline about 1,000 million light-years from the earth, which would be roughly about 6 billion, billion miles. That is 6,000,000,000,000,000,000,000 in numbers, a figure too fabulous for my mind to visualize in concrete terms of distances.

He added quickly that the preliminary evidence of a decline could not be considered conclusive. "There may be a falling in the count only for a certain expanse, followed by another where an increase begins."

To sessions with Dr. Hubble I owe such orientation as I possess on the mystifying process that is taking place throughout the universe, according to all scientific data developed in the last few decades.

Evidence accumulated over a long series of observations since 1929 is that the universe is constantly expanding like some monstrous bubble being blown monstrously more immense. Another way of describing what is believed happening is to liken all the components of the universe to the shower of fragments, gases, and energy a midair explosion would hurl in all directions.

The whole galactic world outside the Milky Way is exploding away from it, according to the hypothesis, at a velocity which increases by 100 miles for each million light-years separating other celestial systems from that miscroscopic bit of cosmic real estate, the earth. Galactic systems are hurtling outward at speeds

of from 38,000 to 75,000 miles a second.

To put it differently, our infinitesimal planet has more "outer" space when these lines were printed than when they were written only a few weeks earlier. Add still more "outer" space for the time it took to get this issue of THE AIRMAN to the very first readers.

With this explosion continuing, science cannot tell us where "outermost" space begins; or when, where, or how space ceases—unless it be endless. If space is not infinite, however, astronomers must know where it ends before they can compute what is the center of space and where is our own galaxy with relation to that center.

Dr. Lee A. DuBridge, President of Cal Tech and a member of the Special Advisory Committee for the Sky Survey, told me that the Sky Atlas compiled by the Big Schmidt would constitute "an astronomical bible for at least a century to come."

His remark gives some index of the vast number of photographic clues the plates contain to guide research not only by the 200-inch Hale but also around the globe by smaller, yet quite powerful, telescopes with optical systems up to 100-inches. This research will enhance man's knowledge of our universe, yet that knowledge must remain incomplete as long as some of that universe lies hidden behind a veil. And perhaps behind that veil, too, may be the key to the secrets of creation.

So the initial question recurs: How "outer" can outer space be? A somewhat similar query was put to Dr. Wehrner von Braun after our first satellite, *Explorer*, had orbited and was coursing triumphantly around the globe.

He pondered his reply a moment in mock solemnity.

"Space is a pretty big place," he said cautiously, then added with the ghost of a smile, "even bigger than Texas."

EDITOR'S NOTE: During recent months the word "space," has been used and misused in almost every conceivable fashion. Expressions such as "outer space," "simple space," "near space," "deep space," even "space supremacy" have cropped up repeatedly in print and oral discussion. As a result, the point has been reached where an ordinary layman has no sure idea as to what many persons—some of them considered authorities—mean by the words they employ. It has become nearly impossible to separate the known from the unknown; the science from mere airy speculation.

This article is being presented to Air Force personnel in an attempt to give them a factual, scientific look at "space." What does man know about space? How far does it extend and what does it contain? Does it have an end? What are the probabilities and limitations affecting man's plans for physical exploration of this mysterious new realm in the future?

To prepare this article, we called upon William A. Kinney, a consultant with THE AIRMAN. He is well qualified to write on this subject interestingly and in a way the layman can easily follow. For some years he was associated with the National Geographic Society, handling reports for the public on major research programs and other projects engaging some of our noted scientists. In 1949 the Society and Palomar Observatory, in cooperation with the California Institute of Technology, decided on the most ambitious undertaking in the history of astronomy—the compilation of a photographic Sky Atlas. The 48-inch Schmidt, the largest wide-angle telescope, had just been completed, giving science the instrument it needed for the photomapping job. To make more detailed study of any unusual phenomena the Schmidt's pictures might show, Palomar's "Big Eye," the 200-inch Hale telescope was available.

As preparations for the Sky Survey began, its Geographic sponsor assigned Kinney to California to familiarize himself with operations at Palomar Observatory and acquire a grounding in astronomy and astrophysics which would enable him to issue regular reports on the survey's progress and significance of its findings that would not only be authoritative but also in nontechnical language, readily understood by magazine and newspaper readers.

In his account on space for THE AIRMAN, Kinney writes with the background developed by intensive study for this survey work and the many hours spent with top astronomers and astrophysicists on the Palomar staff. In addition, he had the opportunity to take a layman's look at various reaches of the heavens from both the Schmidt and Hale observatories and has examined many of the photographic plates which have captured the portrait of the great universe surrounding this far-from-large planet, our earth. Some index of what the National Geographic-Palomar Sky Atlas has done to increase scientific knowledge of the exterior world and far regions of space may be gauged from the fact that today astronomers estimate the Schmidt's plates contain such an enormous number of previously undiscovered heavenly bodies and other phenomena that their individual study and classification will keep observatories around the globe busy for at least a century.

Although Kinney went to Palomar as well informed as extensive reading and briefings can make a layman, he acknowledges that his first look at the heavens through the eyepiece of the Big Schmidt filled him with astonishment and awe. Viewing star fields whose light had been traveling "billions of years before reaching the earth, celestial bodies whose light was enroute thousands of centuries before the first primitive man appeared on our planet," he began to get some understanding of the immensity of the universe.

In the following article, he will take you on an imaginary flight into space immediately beyond our Milky Way for a look at its component solar system in which the earth orbits. Although this observation mission is hypothetical (since we have not the faintest notion when or even *if* man will have the capability to duplicate it in reality), the facts on the organization of the Milky Way and the nature of the space beyond it are facts firmly established by astronomical study, corroborated photographically by the Sky Survey.

Kinney has had this article reviewed for technical accuracy by such notable men of science as Dr. Lyman J. Briggs, Director Emeritus of the National Bureau of Standards; Rev. Francis J. Heyden, Director of the Georgetown University Astronomical Observatory; Dr. Martin A. Pomerantz, astrophysicist advisor in the satellite program and a member of the Bartol Research Foundation of The Franklin Institute, Philadelphia, and Mr. Melvin M. Payne, Secretary of the National Geographic's Committee on Research which Dr. Briggs heads as Chairman. Copyright illustrations from Sky Survey plates have been generously made available by its Society sponsor.

It is hoped that the article will help all to a reliable understanding of what "space" is in broad perspective, its vastness, and the many problems it poses for earthlings eyeing its threshold.

Bomarc missile model undergoes simulated speed runs of up to four times the speed of sound. Engineers watch through a pressure-proof observation window in the supersonic wind tunnel.

THE BOMARC STORY

HOW A MISSILE WAS BORN

by Robert J. Helberg

YIM-99A Project Engineer, Boeing Airplane Company

PHOTOGRAPHS BY BOEING AIRPLANE COMPANY

Bomarc is a word with several meanings.

To most Americans, it means a fierce-looking missile which can reach out and knock down enemy bombers before they can near American homes.

To the Boeing Airplane Company, it means a complete weapon system consisting of a missile, ground-control equipment, ground-support equipment, testing gear, launcher-shelters, and an ability to utilize these equipments almost instantaneously to repel enemy attack.

To the Air Force, *Bomarc* means a new tool to help it do its work, a tool the Air Force soon will be using.

Already a *Bomarc* training wing has been organized: the 4751st Air Defense Missile Wing at Eglin AFB, Fla. *Bomarc's* closeness to operational service is also indicated by announcement of the first four operational *Bomarc* bases. They will be built near Dow AFB, Maine; Otis AFB, Mass.; McGuire AFB, N. J., and Suffolk County AFB, Long Island.

Besides having several meanings *Bomarc* has several spellings.

English aviation periodicals once spelled it *Bow Mark*, apparently on the assumption that the *Bomarc* spelling was some sort of American contraction. Thick-fingered linotype operators sometimes spell it *Momarc*. One wit quickly described *Momarc* as the female of the species.

Actually, *Bomarc* is a coined word: the *Bo* for Boeing and *marc* for Michigan Aeronautical Research Center, a University of Michigan agency which worked on the ground-guidance system early in the program.

To explain what *Bomarc* really is

—that is the purpose of this article.

Maybe the best way to describe what the *Bomarc* missile is is to tell what it isn't. It isn't a ballistic missile.

Ballistic missiles have been getting most of the headlines in recent months because someone called them the "ultimate weapon." Air Force spokesmen have disagreed with this estimate.

A ballistic missile is one that follows a predetermined trajectory so that when it falls, it will fall on a target. A guided ballistic missle is guided only to some point in the atmosphere or space where it runs out of fuel or its propulsion stage falls away. If the point in space has been well chosen, the missile will fall to earth in the right spot.

That's what *Bomarc* isn't.

An area-defense long-range interceptor system. That's what *Bomarc* is.

The *Bomarc* missile is a guided pilotless airplane. It is guided, from the ground, by radio signals, to the target area. The *Bomarc's* target is an invading aircraft, piloted or pilotless. If target conditions require, *Bomarc* missiles may be sent up in salvo, all controlled from the same guidance center.

When a *Bomarc* missile gets to the target area, it takes over its own guidance, homing on the target, and detonating close enough to the target to "kill" it.

In its only official release of information on a *Bomarc* firing, the Air Force revealed that the missile scored a "kill" at a distance of more than 100 miles from its launching site.

Physically, the *Bomarc* missile can be described thus:

A surface-to-air guided missile measuring about 47 feet long with a wingspan of little more than 18 feet. Each wing, with control surface, forms a four-sided figure with no two sides being equal in length or parallel to each other. It took many hours of wind-tunnel testing to develop this wing. It is designed for highly maneuverable, supersonic flight.

The *Bomarc* airframe has tip-type control surfaces. The whole end of the wing moves on a pivot, becoming an aileron. The tip of the vertical stabilizer on the tail becomes the rudder and the tips of the horizontal stabilizer, the elevators.

Such controls give quick reaction in thin air, presenting a relatively large surface for the air to act on.

The missile is powered in flight first by a rocket boost as the *Bomarc*, in a vertical, tail-down position, is cradled in a launcher. Second, twin ramjet engines, which need to be traveling through air at high speed before they can operate properly, take over the propulsion job a short while before the rocket engine runs out of fuel.

An important portion of the *Bomarc* system is a complex of electronic devices and computers which instantly digest available intelligence data on an enemy attack and transmit these data to *Bomarc* launch sites so that the missiles can meet the attack far from vital U. S. targets.

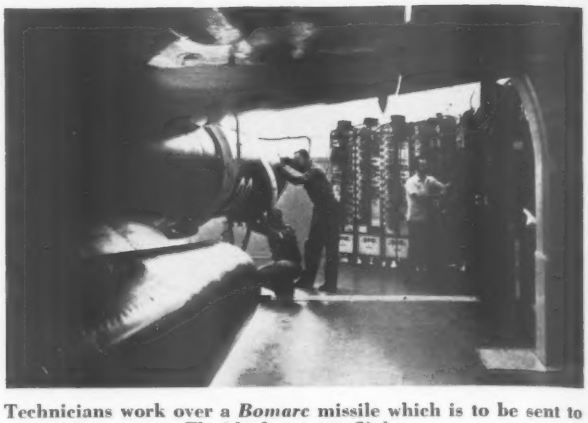
The *Bomarc* IM-99 was designed to fit into SAGE (semi-automatic ground environment), the air traffic control and radar warning system now being developed by the Air Force for this country's defense.

IM-99 is the *Bomarc* missile's official Air Force designation. Like almost all aircraft, however, different versions have different prefix symbols. An XIM-99 is one of the *Bomarc* test-model series fired at Cape Canaveral, Fla., in Boeing's research and development program. The X stands for "experimental" just as it does in conventional Air Force aircraft designations.

Similarly, the Y in YIM-99 stands for prototype or "service test" model. Most of the YIM-99 missiles are being produced for the *Bomarc*

An instructor in Seattle's *Bomarc* training school demonstrates movable control surfaces on a model of the Boeing *Bomarc* missile. Students are Air Force officers from Air Defense Command, and Boeing employees.

Col. R. J. Walling, Air Force representative, inspects the first production model of the *Bomarc* with Lysle A. Wood, Boeing vice president.



Technicians work over a *Bomarc* missile which is to be sent to Florida for a test flight.

training base on Santa Rosa Island near Eglin AFB, Fla.

An IM-99 is the production version of the missile, incorporating design changes developed as a result of the testing program. The IM stands for interceptor missile.

Some of you might be saying to yourselves, "We've got interceptor airplanes. What do we need with interceptor missiles?"

The pilotless interceptor has certain advantages over manned interceptors. A *Bomarc* base is always on ready alert. IM-99s can be airborne in less than two minutes after the scramble order. The IM-99 is faster and has greater maneuverability than a manned interceptor. Yet, it has enough range (250 miles radius, the Air Force has announced) to qualify as an area-defense weapon.

Also, *Bomarc* has tremendous firepower. Missiles can be launched in salvo and, with certain armament, will sweep the sky clean over a wide target area.

To repeat a few lines from a speech made by Lt. Gen. C. S. Irvine, Air Force Deputy Chief of Staff, Materiel:

"If an aggressor nation starts out to attack the United States, the best place to stop its bombers is on their runway. Barring that, the next best place is just as they become airborne. If we can accomplish neither of these, we must make every effort to stop them well beyond the defended areas of our country. We should rely on point defense only as a last resort. For the chances are that if attackers get within point defense range, they will already have launched their air-to-surface missile. It is then just a little late to shoot down the bomber."

General Irvine has stated, in effect, "Be prepared to go get the attacker before he can come to get you." Certainly the *Bomarc* system, with a missile range of 250 miles, with fantastic guidance accuracy, and fired singly or in salvo as the threat requires, is designed for the kind of defense job General Irvine describes.

An Air Force news release said that *Bomarc* missiles "based on Long Island would cast a protective arc along the Atlantic coast from the neighborhood of Boston to approximately Washington, D. C." This is area defense!

Beginning in the fall of 1952, flight tests at Cape Canaveral were conducted to determine the effect of sudden propulsion on the *Bomarc* airframe. No ramjet engines were mounted on the earliest test vehicles. No guidance equipment was included in the missile's makeup. These were tests to see whether the missile would fly.

On the first test flight, the *Bomarc* climbed rapidly to about 300 feet, made three inside loops, and came to earth with a shuddering crash. It had been the first major missile to be test fired at Cape Canaveral.

Such a test, although discouraging, provided us with the answers that make the *Bomarc* missile a proved production item today.

On one of those early test firings, the missile was especially cantankerous. Its firing had run into numerous snags, and the small group of men participating in the scheduled test were on edge as one firing and then another was postponed. The hot, muggy weather aggravated the tenseness.

But this time it looked good. Everything seemed to be working as planned. The count-down reached 30 seconds to blast-off and the anxious men thought, "This is it!" The bird sat ready on the launcher, poised and erect for the flight that now was near.

But as the count-down reached 19, the order came to "scrub" the flight. One of the meters had indicated something wasn't right with the bird.

A loud moan greeted the cancellation.

Then, through the despair, came the voice of Monte Smith, one of the Boeing men in charge.

"Hey, lieutenant," he hollered to the Air Force observer. "You got any smoke bombs?"

"Yeah, we've got some," the lieutenant answered, obviously puzzled. "What in the devil do you want smoke bombs for?"

"Well," drawled Smith, "you take a couple out there on the firing pad and shoot them off. Midst the smoke and confusion, we'll take this #$%& bird out and bury it in the sand."

It was a more relaxed group that went on with the test.

Frustration changed into eager anticipation as the firings began to go well. By 1955 Boeing had a flying article that included both rocket and ramjets operating in proper sequence.

This switch from one source of power to another in flight is no

mean trick. It had given Boeing engineers some sleepless nights thinking about how it could be done every time with no failures. Could the sudden blast of the ramjets pull the missile apart? Would the terrific accelerating blast of the rocket engine shake the missile so badly it would disintegrate?

To the engineers who worked on this problem, the successful transition from rocket-powered to ramjet-powered flight meant victory in a long battle with a complex system of simultaneously acting forces.

A ramjet engine is a peculiar animal. The faster it goes, the faster it tries to go. Conversely, if it begins to falter and slow down, it fails rapidly.

Ramjets of the power used on the *Bomarc*, manufactured by Marquardt Aircraft Co. of Van Nuys, Calif., were a new development in 1955. So, for that matter, was the *Bomarc* rocket engine, built by the Aerojet-General Corp. of Azusa.

And as for the rocket, probably no other engine can shake an airframe as violently. They have been referred to as "kingsize raspberries" because the flame is as red as a raspberry and the sound is that of a million Bronx cheers.

In Seattle, Boeing engineers designed a special "shaker" system that duplicates the vibrations going on in a *Bomarc* missile when the rocket lifts it off the launcher. The vibration test machine is encased in a frame of steel bars and plates. Suspended in a hollow within a two-and-a-half-ton chunk of concrete, the shaker can vibrate from 2 to 2,000 cycles per second, attaining a force 20 times that of gravity.

Vibration is one of the tests that is done on the ground so that costly failures in the air can be avoided. A component of the missile can be mounted on the shaker and given the bumpiest ride it could ever get. If it holds together and still works, then we know the design is okay for a flying missile.

Another ground test helps us cope with the problem of heat generated by the missile's internal electronics plus heat caused by the friction of the air passing around the missile's aerodynamic surfaces. Anything passing through the air as fast as a *Bomarc* missile does is bound to get hot. That means the missile has to have insulation and a refrigerator. How much insulation? How big a refrigerator? That's what had to be found out.

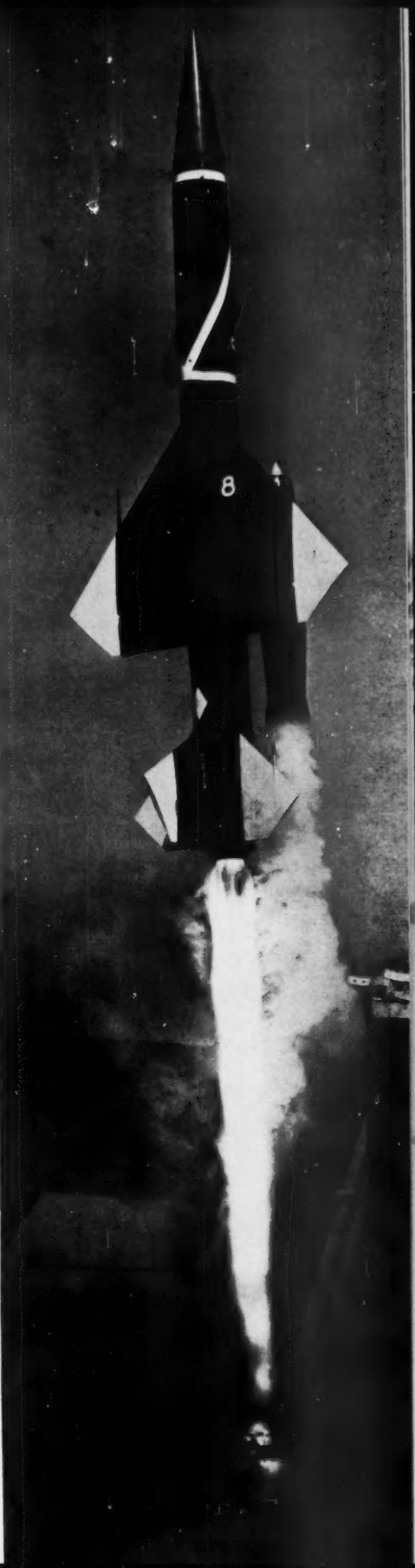
In a shop at the Seattle factory there's an artificial heat barrier. It consists of a huge cylindrical oven heated by infrared lamps. A section of the missile can be placed in the oven and heated to the temperatures it will encounter in flight. If some component of the missile is going to break down because of heat, it can be found and corrected before we send it up in a missile.

There are other tests we do on the ground, too, such as checking out the entire guidance system from pre-launch to intercept. The missile is allowed to hang suspended from leaf springs so that its control surfaces can move freely. Then a simulated-intercept button is pushed and the missile receives all the commands for pre-launch, midcourse guidance. Finally, a simulated target is provided for terminal guidance and control coordination testing. The missile squirms and wiggles and gets a real workout. With no powerplant, of course, it can't get anywhere. But a lot can be learned about how fit the missile is by exercising it in this way.

The trick of fooling *Bomarc* into thinking it is on an actual flying mission is accomplished by giving it guidance instructions from racks of test equipment just as the missile would receive these commands in flight. The missile reacts as though it were attacking an enemy invader. The special test equipment, designed and manufactured by Boeing, not only gives the missile directions, it also records *Bomarc's* reactions to these commands.

Actually, the *Bomarc* missile will make only one flight in its life. But before it arrives at a *Bomarc* base and is installed in the launcher-shelter, it is a veteran of many hours of simulated flight. In fact, you'd have a tough time convincing the missile that it hadn't already nearly circled the earth at supersonic speeds.

Bomarc guidance and target-seeking components actually have been



Here the *Bomarc* rockets skyward split seconds after launching. The missiles can be fired in salvo to intercept individual targets of a mass attacking force.

tested in the air. The radome nose and missile electronics section have been grafted to the nose of a Martin B-57 light bomber. The B-57 goes aloft and the pilot allows the *Bomarc* guidance system to direct his course and altitude. He even makes mock attacks on "target" airplanes at the direction of the *Bomarc* ground guidance system and the missile's own target seeker. The guidance equiment's accuracy and reliability have been checked out exhaustively in this fashion under various flight conditions.

But most of the *Bomarc* component testing has to be completed on the ground. Because the missile is designed to carry a nuclear warhead and because *Bomarc* must be able to operate in an atmosphere that might be contaminated with atomic fallout, the effect of radiation is another study performed under laboratory conditions.

Boeing engineers have traveled to atomic piles at Arco, Idaho, and Los Alamos, N. Mex., to dip *Bomarc* transistors in a nuclear bath. Using information obtained from such tests, engineers can develop transistors resistant to radiation.

A potential hurdle to successful *Bomarc* missile flights at even faster speeds than today is the ordinary raindrop. What happens when a missile, traveling at sizzling supersonic speed, hits a raindrop? Soft as rain water is, it becomes as hard as a diamond-point needle when you try slapping it out of the way at those speeds.

The nose of the missile is the part of the bird most vulnerable to raindrop erosion because it must push the raindrops aside for the rest of the missile body and because it is made of fiber glass. In a Boeing laboratory, engineers sniped at a *Bomarc* radome nose with a .22 rifle. The rifle shot imitation raindrops instead of bullets. The raindrop, a plastic pellet of average raindrop size and weight, hit the radome at speeds up to 4,500 miles an hour. With information developed from such tests the *Bomarc* nose has been designed to penetrate rain storms that might be encountered during flight.

Among the most important tests of all are the hours of flight logged by miniature *Bomarcs* in supersonic wind tunnels. For such tests the missile model is anchored in the tunnel and the air blown in at speeds up to 3,000 miles an hour. Aerodynamic design changes can be checked in this manner. The wind tunnel is a designer's tool used for checking every significant change to the missile airframe on the forces that are a part of missile flight performance.

Boeing missile models have logged more than 6,000 hours of flight in wind tunnels. The tests started back in 1945 when Boeing entered the missile field with what was called *Gapa*. *Gapa*, the initials of ground-to-air pilotless aircraft, was a short-range antiaircraft missile with a speed of 1,500 miles an hour and a kill performance altitude of 6,000 to 80,000 feet.

The *Gapa* project was discontinued in 1949 when the Army received responsibility for missiles with a point defense mission. But formalized work on *Bomarc* started soon afterward and the wealth of technical data collected on *Gapa* was put to full use.

The first *Bomarc* missile rolled off production lines in Seattle, Dec. 30, 1957. About a month later, the Boeing company revealed it had been working on an advanced *Bomarc* for the Air Force for some time.

The advanced *Bomarc* is well along in its developmental stages. It will have solid rather than liquid rocket boost propellant and substantially more range than today's missiles. The range, roughly equal to the range of manned interceptors contemplated for the same time period, will enable the missile to down attackers even farther from their targets.

There is still a third interceptor missile being studied at Boeing. This one is also nameless but can be considered a member of the *Bomarc* family. Its designed mission, as you might guess, is the interception of ballistic missiles.

Little more can be said about either of these two advanced missiles at this time—they are mentioned because they indicate the vigor with which advanced projects are being pushed.

By now you should know pretty well what *Bomarc* is.

To the men of USAF's Air Research and Development Command and Boeing, *Bomarc* is:

Twelve years of wind tunnel testing and supersonic research.

Hours of frustration and heartbreak.

Moments of elation.

Years of achievement.

Many scientific firsts.

A future of limitless possibilities.

To the Air Force and the country, *Bomarc* is an area-defense system with tremendous firepower.

Bomarc, a member of a team of Air Force defending champions, is the one wearing brass knuckles. ★

A B-57 light bomber modified to carry the *Bomarc* nose and guidance package aloft. The pilot follows flight instructions received from the *Bomarc* guidance system as he makes mock attacks on aerial targets.

This is second in a series on monuments and shrines to airmen who have written a historic chapter in the chronicle of world progress.

THEY GREW THE WINGS

by M/Sgt. Hal Bamford

SOME 65 MILES southeast of Norfolk, Va., as the crow flies, the windswept dunes and beaches of the Outer Bank of northeast North Carolina house a collection of historical sites.

Two of these sites are historic birthplaces. At one, Virginia Dare, the first English child born on North American soil, first saw the light of day in 1587.

The other is Kill Devil Hill, near Kitty Hawk, site of the famed birth of heavier-than-air flight by the Wright brothers on December 17, 1903.

The memorial shaft to the famous Dayton, Ohio, brothers is the center of this famed area. A 60-foot triangular pylon of gray granite, it tops 90-foot Kill Devil Hill.

Last year this monument reached the ripe old age of a quarter century. Authorized by Congress in 1927, the cornerstone was laid on December 17, 1928, 25 years after the historic flight, and on November 19, 1932 construction was completed and the memorial dedicated.

The shaft stands approximately a quarter mile south of the takeoff point for the initial successful flight. Markers have been placed around the area to indicate the first runway and each of the distances flown on the four hops that historic day.

Just behind the takeoff marker, immediately to the north, the two buildings which were used as cabin and hangar by the brothers, have been faithfully reproduced. Even shelves within the cabin have been stocked with reproductions of the food stores used by the aviators.

When initial plans were drawn for construction, National Park Service officials estimated that because of the isolation of the area the monument would never draw more than 3,000 visitors a year. However, in 1933, the first full year it was open to the public, more than 8,000 devotees paid homage to aviation's birthplace. In 1956, the total topped 300,000 and present estimates foresee the annual total topping half a million within the next decade.

The legendary origin of the name Kitty Hawk itself seemed to prophesy a destiny in flight. Years ago, high flying Canadian geese on their southern migration were hunted by Indians who traveled to the Outer Bank near Nag's Head from southeastern Virginia and North Carolina.

When the white man arrived, the Indians were queried about their annual hunting pilgrimage. In "pidgin English" they explained that though the Outer Bank had no name, it was called "the place where they killy honker." Years and the white man corrupted the phrase to Kitty Hawk.

DAGGER N

Most recent addition to the defe e force equipped fighter-interceptor squadro Now fu as part of the 10th Air Division are e 317th ron and a sister unit, the 31st Figh r Inter

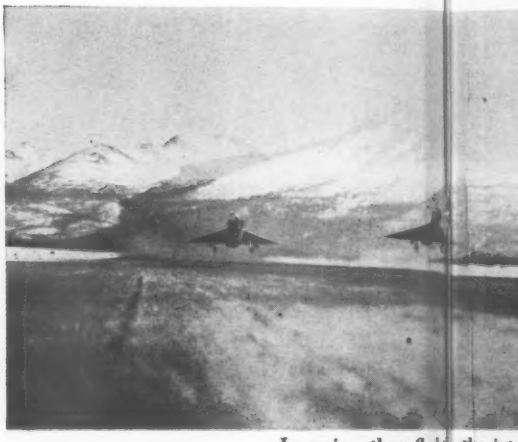
Movement of the two squadrons to laska lo new sting to our northern defenses but arks th all-weather interceptors have been si ned to three bomb bays full of folding fin ro ets *Delt* 50,000 feet and are rated at Mach 1 plus.

There's a time for waiting. Then the bell rings.

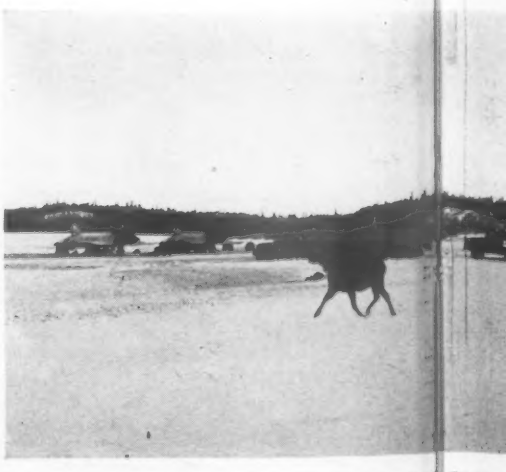
317th Fighter Interceptor Squadron

31st Fighter Interceptor Squadron

Meanwhile, out on the ramp . . .



In pairs, they flash the inte



Scaring the skan mo

R NORTH

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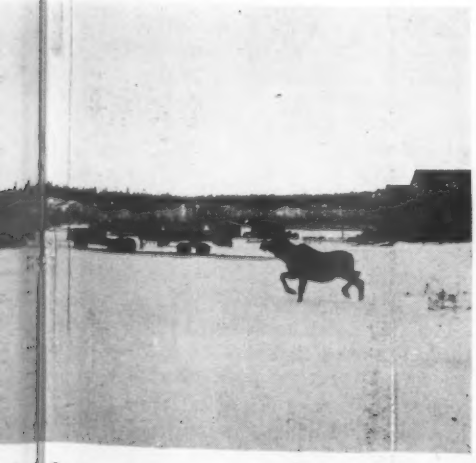
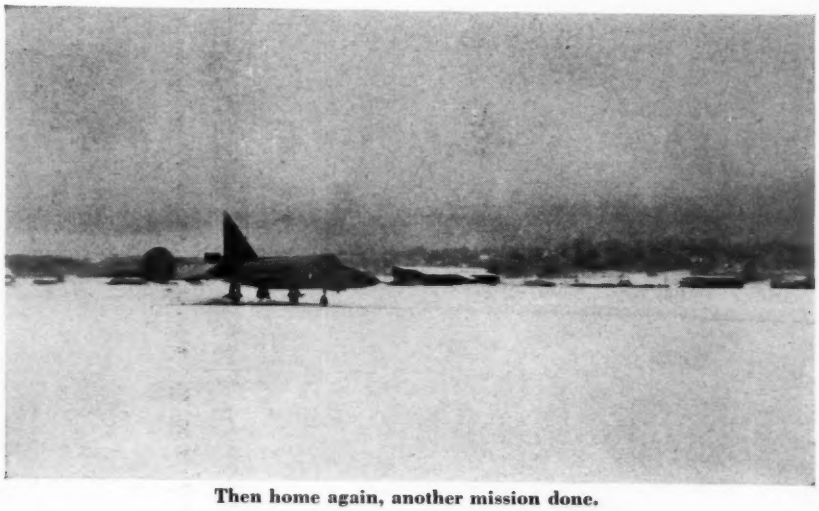
flash the intercept . . .



the skan moose.

And disturbing the mountain known as Big Susitna, the Sleeping Lady.



Then home again, another mission done.

But they must prepare for tomorrow.

This is the McMurdo Sound landing strip, hard to see on a bright day, impossible when the white weather closes in.

Antarctic Airlift

MATS SUPPORT OF THE IGY IN ANTARCTICA—A FURTHER DEMONSTRATION OF GLOBAL CAPABILITIES

by M/Sgt. Ed Blair

STRONG, BRIGHT, but diffused, sunlight flooded the cockpit of the C-124 *Globemaster* and both men intently peered through dark sunglasses into a milky whiteness. The added warmth of the sun was enough for the pilot to remove his shirt and he sat there in a brilliant red undershirt — the long-sleeved, winter-weight kind. But the mukluks and heavy woolen clothing were evidence that it was plenty cold outside. There was a click in the earphones as someone keyed a transmitter.

"We can see you now, MATS 5184. You are a great, big, wonderful, beautiful sight," Lt. (jg.) John Tuck radioed excitedly to Col. William G. Forwood, the man in the red underwear.

Naval officer Tuck was military commander of the U. S. International Geophysical Year facility at the geographic South Pole. It was noon, October 17, 1957, and for the 18 men of Dr. Paul A. Siple's scientific party who had wintered over at the pole since last March, this was the first visual contact with the outside world. Colonel Forwood sat in the left seat of the big C-124 with Continental Division, Military Air Transport Service markings, and prepared to paradrop the first supplies to reach the isolated scientific station in eight months. He commanded the Airlift Task Group.

The tiny camp huddled, half-buried, in the snow that raises the Polar Plateau to 9,200 feet above sea level here. A few hundred yards beyond, 158 black fuel drums circled a centered single drum that anchored an American flag. Scientists had made

more than 400 star sights to fix the South Pole within the circle. Iridescent cloth panels between the camp and the circle marked the drop zone. Capt. Martin Nisker, staff navigator for MATS' 53rd "Black Jack" Troop Carrier Squadron, corrected the *Globemaster's* course slightly as it roared toward the panels.

Down in the cavernous cargo compartment of the Douglas C-124, everyone was on station. A group of VIPs, including the American Ambassador to New Zealand and the New Zealand Minister of Labor, pressed close to frosted windows, straining to be first to sight the little cluster of huts. Sir Hubert Wilkins, 69-year-old cold-weather expert of the Army Quartermaster Corps and first man to fly in Antarctica, (1928) stared reflectively out a window. Thirty-four days ago he had flown over the North Pole in another plane like this.

The elevator doors opened with a swoosh. Temperature inside the plane dropped sharply. Outside the cockpit the Indian Ocean-warmed air temperature was minus 45 degrees. Seven hundred feet below, the polar weather station registered minus 60 degrees. Moisture breathed into the cabin by crew and passengers immediately turned to frost crystals that swirled out into the slipstream. Airspeed was 130 knots.

T/Sgt. George D. McNamara, wearing bright green wind-breaker pants and parka, braced himself. He held a razor-sharp knife ready to cut the nylon web strap that was pulled taut as a bowstring by the 40 barrels of diesel oil it restrained. He had done this before at isolated radar sites and ice islands in the Arctic, during airborne infantry maneuvers, and last year, he had helped drop the lumber and materials to build the camp below.

Directly across from McNamara, M/Sgt. Thomas A. Lee, the dropmaster, crouched at the edge of the open well. He listened to Captain Nisker count down over the intercom as the plane closed on the drop zone. ". . . two, one, drop, zone, now!" Lee's hand chopped down just as the snow-dusted orange buildings of the pole station streaked across the open well.

Mac's knife sliced cleanly through the gate strap almost in unison with the dropmaster's downward stroke. Five seconds later only the passengers and one small bundle of mail, food, and spare machine parts were left in the big cabin. On the next pass this bundle dropped almost in the lap of a man rushing out in a weasel to pick up precious letters from home.

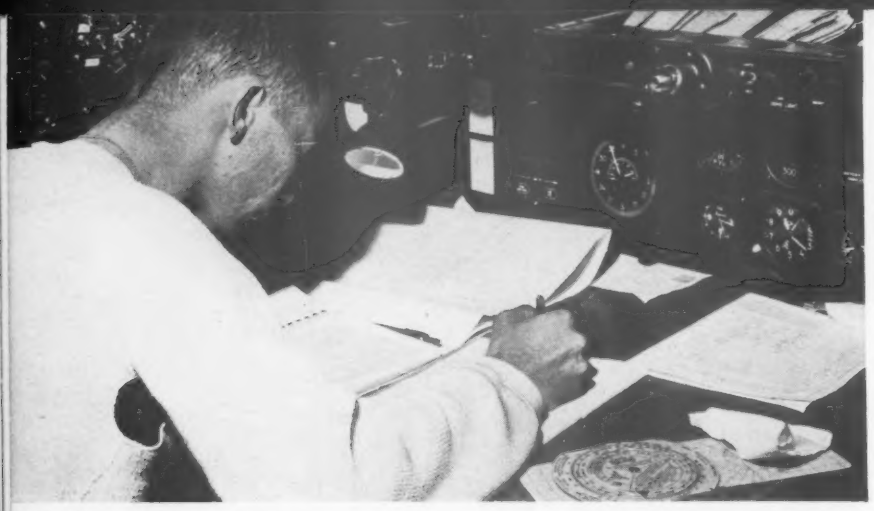
The plane now swung back toward Beardmore Glacier. This glacier, its broad face pocked with deep crevasses, stretches approximately 100 miles from a 7,500-foot lip of the Polar Plateau to where it pushes its tongue out onto the Ross Sea Ice Shelf. It forms a natural, though treacherous, highway that was used by the British explorer Capt. Robert Falcon Scott on his tragic trek to the pole in 1912. The well charted peaks rising over 13,000 feet on either side and the crevasses that give a radar return, make it a natural airway for the *Globemasters* too.

Capt. Victor Stianchi took over the flight deck after the plane nosed down over the glacier and Colonel Forwood went back to chat with J. K. McAlpine, the New Zealand minister, and the Honorable Francis H. Russell, the U. S. Ambassador. The loadmaster, A/2C Bobby Bruce, had just passed out lunch—IF-7 Flight Rations—still slightly frozen. Colonel Forwood found the statesmen comparing the relative qualities of their cold canned chicken and swiss steak. As they talked they ate them with apparent relish.

The 18,000 pounds airdropped to the pole that day was just the first of 753 tons MATS delivered via parachute to U. S. IGY stations in Antarctica during Phase Three of Operation Deepfreeze. The tonnage had been revised downward from an original commitment of 950 tons because of a fuel shortage at the McMurdo Sound staging base.

Included were 13 tons of an IGY deep core drill rig that is an important part of the snow and ice studies. A few months earlier the Army Corps of Engineers drillers had used it to take samples from 1,500 feet in the Greenland Ice Cap at 79 degrees North latitude. Some of the samples had contained windblown volcanic ash from the 1912 eruption of Katmai (Alaska) and the explosion of Krakatau (East Indies) in 1883. They hope to find similar evidence in Antarctica at Byrd Station—80 degrees South latitude, 120 degrees West longitude. MATS airlifted the rig from Thule, Greenland, and dropped it at Byrd Station—the only way this particu-

An engine dolly on a sled was shoved into place by a tractor. A piggy-back hoist lifted the engine into place. Hoist weighs 1,200 pounds, is carried piece by piece over wing and assembled in an hour-and-a-half—when the wind permits.



In the higher latitudes magnetic compasses are useless and sun lines hard to plot on charts with fast-converging meridians. The navigator works constantly, plotting positions by dead reckoning on a special grid chart.

lar piece of equipment could have traveled from pole to pole in time for use during the IGY.

Aerial delivery is a new role for MATS that has broadened its basic mission. Since 1948 when this unified command was created to provide airlift support simultaneously with employment of strategic striking forces, it has moved millions of pounds of cargo, passengers, and patients.

Training has been practical. Transport crews fly scheduled missions with real cargo and passengers manifested and processed by competent traffic personnel. All MATS peacetime flights are training missions—with payloads that reduce materiel stockpiles and personnel pipeline time. A radioed message can change a training flight into a wartime mission in minutes.

A 115,000-mile network of global air routes was built. Supporting services—air-to-ground, point-to-point, and navigational communications of Airways and Air Communications Service; Air Weather Service; Air Photographic and Charting Service; and Air Rescue Service—are used by Air Force and other defense agencies.

Now, the 53rd TCS, part of the 63rd Troop Carrier Wing transferred to MATS from Tactical Air Command last July, was paradropping supplies at the South Pole in support of an international scientific exploration unparalleled in history.

The engineer, T/Sgt. Raymond Beckwith, like Sir Hubert, had flown over the North Pole three months earlier while on a paradrop mission to T-3, a floating ice island in the Arctic Ocean and former Air Force weather station now better known to IGY people the world over as U. S. Station Bravo.

Very few of the men in 53rd TCS were strangers to cold-weather operations in the higher latitudes. All the aircrews and most of the maintenance personnel had participated in the Dew line project since 1955 or resupplied T-3 and other remote Arctic stations out of Thule, Greenland. Capt. Jack Wrinkle, 53rd's chief pilot, Capt. Kenneth Blan, a senior aircraft commander, and Blan's engineer, T/Sgt. Hollis E. Hall, had helped pioneer C-124 cold-weather operations in Alaska.

Dr. Lawrence Gould, director for the IGY program in Antarctica, talking to a group of sailors, airmen, and scientists at a Thanksgiving Day ceremony at McMurdo Sound said:

"The heroic age is still here. I would rather take the trail with dogs again than attempt to maintain mechanical equipment under conditions you are working under."

Twenty-eight years ago Gould with five men sledged 2,000 miles with dog teams on an exploration from Little America I. Antarctica, over five-and-one-half million snow-covered square miles, is the coldest place on earth and it has no mercy on either man or his machines. So far, man has endured better than machines.

Mechanical troubles are intensified and complicated by the extreme cold. *Globemasters* sitting out a blizzard on the bleak ice strip, or even being serviced for a turnaround flight from the sled-mounted refueling unit, become cold-soaked fast. Preheating equipment and ground power units, once shut down, take hours to restart. Without preheating, engines are forced from metal-brittling cold to cherry-red heat within minutes.

The Antarctic Airlift got started in earnest October 18, and so did the mechanical troubles. The second of two planes was well along toward Byrd Station 800 miles east of McMurdo when T/Sgt. Ray Beckwith noticed his oil quantity dwindling fast. The engine analyzer indicated a blown cylinder. Seconds later he had the propeller feathered and the engine stopped.

Aircraft commander Stianchi radioed for and received permission to proceed with the drop rather than jettison the load in the wilderness. The tee marker and buildings were barely visible through the hazy white weather. To maintain 130 knots and 700 feet above the station on three engines he kept the plane's nose high.

The ten 1,600-pound bundles on the forward rollers went out at express train speed. Each bundle shot a little farther across the open well before it toppled downward. The last one went all the way and smacked shudderingly hard against the bottom of the elevator well—right where far-sighted planning had caused extra stringers and trusses to be installed to strengthen the air frame just in case this happened.

As they started home the radio transmitter quit. When no position report was received, Captain Wrinkle, flying the first plane, was directed to turn back and escort Stianchi's crippled plane.

Although the 53rd TCS was operating "A" model C-124s, which are slightly less powerful and not so heavily stressed as the later models, all of them had been modified and beefed up at the wing roots and around the elevator well for this

type of mission. It enabled them to increase the payload with a greater safety factor.

A Transport Control Center duty officer at Travis AFB, Calif., at first refused to clear Capt. Ralph R. Garrison, one of the Black Jack pilots enroute to New Zealand. Garrison was grossing his aircraft out at 185,000 pounds, a full 10,000 pounds over MATS maximum allowable gross weight for C-124As, and this officer knew his MATS regulations. Captain Garrison finally convinced him that the modification made it legal. A TWX from Headquarters, Continental Division, clarified the matter for later flights.

Captain Wrinkle wasn't the only one to assume the role of Air Rescue Service. Once the squadron commander, Lt. Col. Dixon Arnold, took off from New Zealand to intercept a troubled crew. Capt. Vincent J. Descesare was 900 miles out of Christchurch with two heavy trucks aboard when T/Sgt. Ranny B. Bice feathered the prop on an ailing engine. Minutes after they turned back another engine became troublesome and although Bice nursed it carefully he couldn't coax full power from it. The second engine failed completely on final approach at Christchurch and a third coughed ominously just before touchdown and safety.

Ten days later this same crew was just 100 miles short of Byrd Station when number one engine froze mechanically. On three engines they parachuted their 15 tons of oil. Halfway back to McMurdo a red firelight blossomed on the instrument panel and Bice feathered number three propeller with a generator fire.

Unlike MATS' scheduled flights, the 53rd carried only one engineer and a flight mechanic. Bice's mechanic, S/Sgt. Charles T. Featherstone, had lost his generator wrench in the snow the day before. But with the tools available he and Bice crawled out to the accessory section and tried in vain to remove the generator so they could restart the engine. While they worked, S/Sgt. William A. Murton, the loadmaster, rode the panel seat. With a dead engine on each wing, Captain Descesare greased the *Globemaster* in on the rough ice runway without incident.

Air evacuation of sick and wounded is an integral part of MATS' mission. Kept warm in sleeping bags, the 53rd airlifted a sick sailor and an injured scientist from Antarctica.

The maintenance crews started to work on another "sick bucket of bolts." So long as they worked right everyone referred to the monstrous, clumsy-looking C-124s as "real little jewels." The line mechanics and engine-change crews were the real backbone of the entire operation. They battled the man- and machine-killing cold literally barehanded. The wind at McMurdo Sound is constant and cold—subzero cold. It blows for 2,000 miles across an ice plateau 13,000-feet high where centuries-old snow has melted so little the glaciologists can't find crusts to show yearly accumulations.

Like the flight crews, most of the maintenance crews had served their apprenticeship in the Arctic along the Dew line. Many of the NCOs like T/Sgts. John Kershow and George Pease, who shared line chief duties for many weeks, had as many as three or four winter seasons under such conditions.

"The worst thing about this operation," said Kershow, "is all the oddball things that happen. We've operated under these conditions before and thought we knew what to prepare for. We've got good mechanics, men like A/2Cs Chester Wireman and Roy 'Porky' Long, who know their business and learned it in cold weather. But none of the things we expected has happened."

Pease agreed with him. Biggest gripe of the post-flight crews according to S/Sgt. William Underwood and his boys was the fact that so much had to be done by hand. For instance, it took about 20 minutes to drain a five gallon oil can after it was carried across a slippery wing in hands covered with greasy gloves.

Normal post-flight maintenance was an extended nightmare in the cold cruel winds. The mechs would get a plane in the air, wipe their greasy hands on a warm cloth, climb into an open weasel, and ride two miles through biting cold to the mess hall. They would gulp gallons of hot chocolate and a hot meal, then relax with a cigarette in the steamy warmth before going back for another eight or 10 hours work.

Five times they made engine changes on the ice strip under such trying conditions. On the first engine change they were caught by a two-day blizzard just as they started to hang the new engine. Fortunately, they were able to bolt it well enough to hold against the winds. They worked a whole day after the storm digging out tools, power units, and heaters, and getting them going again. Twice during blizzards, the wind caught one of the 70-ton planes beneath the wings and sat it down hard on its tail skid. Only the softness of the snow prevented major damage.

The weather defied forecasts made by Task Force 43's aerology section. Forty stations, seven of them American, participating in the IGY program, made daily reports on which

At Harewood International Airport, N. Z., MATSmen Roberts and Marshall manned the GCA unit. Pilots practiced on every takeoff and landing.

forecasts were based. MATS Air Weather Service was represented by Lt. Robert Greenlee, S/Sgt. John H. Bugbee, a veteran of Deepfreeze II, A/2C John Griffin, and A/3C Roger Larmee who prepared the sectional forecasts for planes flying to McMurdo from New Zealand.

The capricious Antarctic weather contributed to the most dramatic and hair-raising incident of the season. Shortly after Capt. James H. Thomas took off for a pole drop the weather at McMurdo turned nasty, the wind shifted, and blowing snow obscured everything. Storm condition zero was set—only in extreme emergencies could anyone venture outside the camp perched on the volcanic hillside two miles from the flight line. The crash and GCA crews — Navy personnel — were deemed emergency groups.

Two hours out on the way back, a fire in number three engine forced the engineer, T/Sgt. Donald Fetterman, to shut it down. The *Globemaster* was diverted to an emergency strip hidden in a box canyon at Cape Hallett 400 miles north of McMurdo Sound. Cape Hallett had no GCA unit and a half hour later they radioed that weather there was zero-zero. Thomas elected to return to the relative safety of McMurdo's GCA.

Twice he made a GCA approach down toward the bumpy ice runway that he couldn't see, crabbing into a gusty 30-knot crosswind. A blanket of blowing snow 100 feet thick obliterated the brilliant dayglo flags and five-foot-tall pine trees that marked the strip. On the third approach, Captain Thomas asked his engineer how much fuel was left and made his decision.

"Directly under the nose I could barely make out the runway," Thomas told later, "but I couldn't see a thing except white horizontally. I had no way of knowing how much runway was ahead because I couldn't see the markers at the side. So, I did what I had to do."

He throttled back and the huge plane touched down—still crabbing into the wind—on the right main gear and bounced. He corrected a skid and lined up the nose wheel with the frozen tire marks that he could barely see in the snow. Only two propellers reversed but they and the howling wind stopped him. The crash crew sighed with relief when the big red tail swept past them and slowed.

On December 1, the last drop was made at the pole—a D-4 tractor. It replaced one dropped earlier that had cut through its parachute harness and smashed into the hard-packed snow. But this time the 14,000-pound monster floated gently down under four 100-foot canopies and station personnel had it running within 20 minutes. Group Captain T. J. MacLean DeLange, Royal New Zealand Air Force, was a guest on this flight.

"Bang on—a jolly good drop, that one," he commented in typical Kiwi fashion.

The pilot, Capt. Jack Wrinkle, swooped low over the station and waggled the wings of his flying warehouse in farewell to the 17 men wintering over there. Their thanks for the time-saving deliveries crackled over the radio.

"Those (drops) of the past few weeks especially, have saved us many hours of work due to their accuracy."

"Operation Deepfreeze has been a perfect example of cooperation between all the military services," Rear Adm. George Dufek told THE AIRMAN. "We talked over the airlift requirements and decided how much would go where. The 18th Air Force started the lift last year and they did a fine job. This year MATS did equally well. Under the conditions here, I consider the job bigger than the Berlin Airlift. We worked in perfect harmony. The manner in which this most difficult and hazardous of peacetime airlift and air drop missions has been accomplished on schedule is a credit to the Nation and the United States Air Force."

But to the MATSmen of the 53rd TCS it was just another job. This week they may be hauling missiles to Maine, spare parts to Spain, or troops to Thule.

Some jobs, such as threading safety wire through a tiny hole clogged with wind-driven snow, had to be done with bare hands no matter how cold it was.

AIRMAN'S WORLD

RENEWED BITE

New teeth have been inserted in Joint Travel Regulations.

Basically, the contents assure overseas commanders that they have the authority to return military dependents to the zone of interior for conduct prejudicial to the Armed Forces.

Upon expulsion of a dependent, the appropriate District Director, Immigration and Naturalization Service, will be notified of the reason, date of arrival in the United States and port of entry, and be requested to recall the passport of the offender.

The Department of State will be requested to place a passport refusal card on file for the penalized party.

The sponsor's tour of duty will not be curtailed by such action and the expelled dependent is prevented from returning to the overseas area during the sponsor's current tour.

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NEW HOME

Accounts for more than a million GI insurance policyholders have been transferred to a new home office in Philadelphia, Pa.

All holders of USGLI policies which originated during World War I and those holders of NSLI policies of WW II or post-Korea, who are paying premiums by allotment from either active or retired military pay, are affected. Additionally, any policyholder residing in a foreign country will call the Philadelphia district office, "home."

In the future, all documents and communications regarding these policies should be addressed to Veterans Administration District Office, P. O. Box 8079, Philadelphia 1, Pa.

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IT'S COLD OUTSIDE

M/Sgt. Sherrill Bailey and T/Sgt. Joseph Veraldi, 2004th AACS Sq, Sondrestrom AB, Greenland, were recently awarded certificates of achievement for a "hairy" GCA save they performed last fall.

With weather well below minimums, Sondrestrom officials were advised a PBY was enroute to their station from Narsarssuak, Greenland, with a severely injured Danish child aboard. The aircraft arrived in early evening with the ceiling at 200 feet obscured, visibility less than ¼ mile, and snow falling.

The pilot informed the base a short fuel supply would not allow him to proceed elsewhere. Just as he was cleared for a GCA approach, the precision scope went out. While the pilot churned around in the heavy soup, maintenance men installed a new unit.

Sergeant Bailey then vectored the aircraft into the pattern through means of search radar while Sergeant Veraldi aligned the newly installed precision equipment.

Final touchdown was accomplished without incident and three days later the injured child was transferred to Denmark via a commercial airliner.

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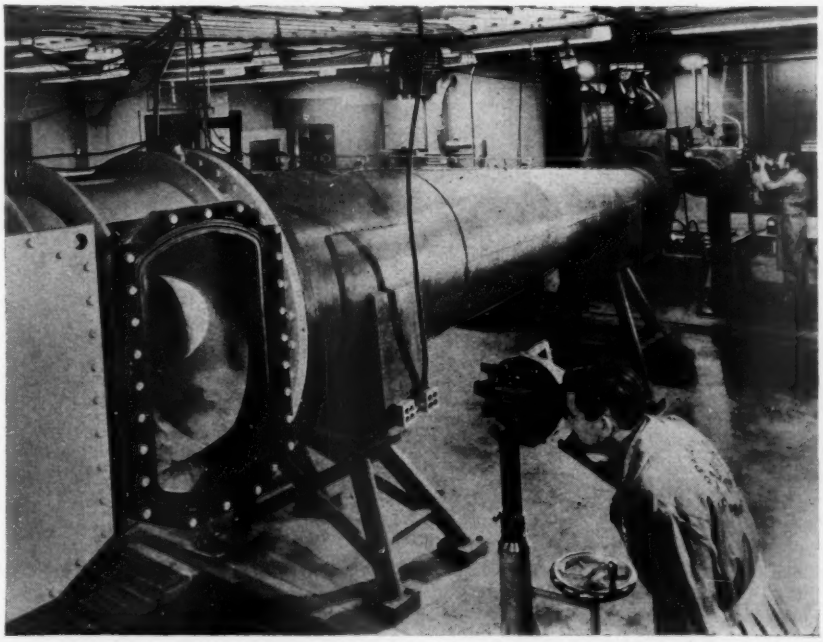
QUICK DRAW

Hq USAF has authorized major commands to immediately step-up small arms marksmanship training for air police, aircrewmen, base security personnel, and other USAF members requiring use of such weapons in performance of their duties.

To facilitate the training in the most economical manner, .22 calibre rifles and pistols will be utilized in the program designed to teach small arms care, cleaning, storage, and safety procedures.

Although present emphasis is being placed on the training of personnel normally required to use small arms, all active-duty and ready-Reserve people will be expected to qualify at the marksmanship level as the program progresses. (See *The Air Force is Learning to Shoot,* THE AIRMAN, Nov. '57.)



WHOOSH!

ARDC recently disclosed that escape velocity has been reached in advanced wind tunnel tests. Escape velocity is the minimum speed required to propel planes or missiles out of the earth's gravitational field.

A test velocity of 32,400 m.p.h.—seven miles per second—was reached in *Tunnel Hotshot II* at Arnold Engineering Development Center, Tullahoma, Tenn.

Tunnel Hotshot II, an enlarged and improved version of a similar tunnel which has been in operation at Tullahoma for an extended period, features a 50-inch diameter test section—big enough to accommodate large-scale models of missile nose cones.

Scale models of the USAF's *Atlas, Titan,* and *Thor* missiles have already been tested under less rigid conditions in the smaller *Hotshot I.*

LOW LEVEL ESCAPE

A modification of B-5 parachutes enables crews of fighter type aircraft to successfully bail out at low altitudes.

The modification is accomplished by installing a snap hook on the arming lanyard end opposite the lap belt or ring. This provides a direct connection between the lap belt and the manual ripcord release when the hook is attached to the "D" ring. The aneroid in the timer is bypassed. When the automatic lap belt opens, the separation of the crewman from the seat causes the manual operation of the parachute. However, the crewman must disengage the hook early during climbout.

Successful bailout is possible at 100-foot altitudes from the McDonnell F-101 and Convair F-102. Bailouts at 150 feet are possible from the Lockheed T-33 and F-94, North American F-86, and Northrop F-89.

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TULLAHOMA TALES

A new ramjet test installation, designed to improve safety and increase the rapidity and efficiency of early testing methods, is being placed in operation at ARDC's Arnold Engineering Development Center, Tullahoma, Tenn.

The installation will be made in one of the present engine-test cells at AEDC and will enable engineers to "test fly" ramjet engines at speeds up to 2,500 m.p.h., temperatures of approximately 650 degrees F., and altitudes above 90,000 feet.

Designed and built by General Dynamics Corporation, the new device has been dubbed a "variable Mach number and angle of attack nozzle." The new nozzle is actually a modification of a similar unit which has been in operation at Tullahoma for an extended period.

Improvements include a higher temperature airflow and increased capability to simulate climbing and diving test conditions by altering the airflow inlet angle.

Although primarily designed for ramjet testing, supersonic test conditions can also be duplicated for turbojet engines.

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FOR POSTERITY

Maj. Gen. James E. Briggs, Superintendent of the United States Air Force Academy, recently accepted a historic collection of memorabilia pertaining to the career of the late Gen. Henry H. "Hap" Arnold for the Academy Museum.

The collection, which was presented by the widow of the former Army Air Force Chief of Staff, includes the general's wartime file, a small portrait photo of him upon graduation from West Point in 1907, the Arnold family album which covers his 39 years of active service, and several additional items.

The material will be placed on display in the museum building at the Academy's temporary site at Lowry AFB, Colo., and will then be moved to Colorado Springs when the Academy occupies its permanent buildings later this year.

Capt. William Coop is presently in charge of the Academy Museum.

THE TIE THAT BINDS

A plastic disc would hardly be considered an important link between airborne crews and ground-bound radar directors—at any place other than Air Defense Command, that is.

ADC, however, has adopted just such a device as a means of tying the director closer to the cockpit and establishing a means of standardizing the closely coordinated intercept operations.

The guide provides a swift, reliable method of determining tactical components of fuel monitoring guidance, a mission profile display, missile attack information, and detailed performance data at all altitudes, power settings, and under IFR or VFR conditions.

It consists of two rotating, quick-reference discs. One is 10 inches in diameter and is used by the ground director; the other, for the aircrew, is six inches in diameter. In production are several models which will cover operations for the North American F-86D and L models, Northrop F-89J, Convair F-102, Lockheed F-104 and T-33, and McDonnell F-101B.

The tiny plastic tool was designed by Lt. Col. Vincent Gordon, assistant director of operations and training, Central Air Defense Force, Richards-Gebaur AFB, Mo. Colonel Gordon is well known throughout USAF circles as the former leader of both the *Skyblazers* and the *Sabre Knights*, aerial demonstration teams.

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IBERIAN TRANSPLANT

Sixteenth Air Force personnel are now operating command headquarters at the permanent site of Torrejon AB, main installation of the SAC complex in Spain.

They completed the move in February after communication facilities became operative. Prior to occupying their new quarters, personnel of the 16th had been operating out of temporary office locations in Madrid.

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SMOOTH STOP

A new liquid-cooled braking system, developed by the B. F. Goodrich Aviation Products Co., has been successfully tested by ARDC engineers at the Wright Air Development Center, Wright-Patterson AFB, Ohio.

Utilizing a coolant fluid to transmit heat generated by braking friction to a heat exchanger, the system reduces excess wear and maintenance problems to a minimum as well as improving the safety factor in braking action. It weighs approximately the same as systems presently installed in operational aircraft.

Landing speeds ranging from 60 to 160 m.p.h. have been used in tests without noticeable brake "fade" resulting. At full static engine runup, prior to and following such landing tests, the new brakes have maintained the aircraft in a completely immobile attitude.

Additional tests are presently being programmed for the Boeing 707 jet transport, the civilian version of the KC-135 tanker.

DUAL GIFT →

USAF's museum will add two old veterans to its hall of fame. One, a gift of the Guatemalan Air Force, is the last flying Boeing P-26 in existence. It will be on extended loan from the Smithsonian Institution to the USAF Museum at Wright-Patterson AFB, Ohio.

The other less ancient veteran is a refurbished B-25 *Mitchell*, restored to the original configuration of the B-25s used by Doolittle's Tokyo Raiders.

The P-26, often described as the link between the old and the new, was the first all-metal, low-wing pursuit plane used by the Army Air Corps. It was also the last of the open cockpit fighters and despite some tricky handling characteristics, it was well liked by most pilots. Placed in service in 1934, some were still in use at the beginning of World War II.

In 1943, Guatemala purchased seven of the 120 m.p.h. fighters. In January the Guatemalan Air Force, in reply to inquiries by the Smithsonian Institution, gave the last P-26 to the United States. A Fairchild C-119 of the 1739th Ferrying Squadron flew to Guatemala City and brought the historic prize home.

At Wright-Patterson AFB, the aircraft is presently being refurbished by members of the USAF Museum staff. Eventually it will join such aerial pioneers as the *Spirit of St. Louis*, Wiley Post's famed *Winnie Mae*, and *Glamorous Glennis*, the Bell X-1 which rocketed past the speed of sound on October 14, 1947.

North American Aviation, Inc., agreed to modify a surplus B-25 recently obtained by Doolittle's raiders. Refurbishing will soon be completed and on April 18 the aircraft will be flown to Las Vegas for presentation to Doolittle during the raiders' 16th annual reunion.

On that date in 1942, the famed Tokyo raid was launched from an aircraft carrier in the Pacific. Flying North American B-25s, Doolittle and his men blasted Japan's capital city. All but one of the aircraft either crash-landed or were abandoned. The remaining one reached Vladivostok, Russia, but has never been recovered.

General Doolittle will present the aircraft to a USAF representative as a permanent addition to the official USAF Museum.

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NAME, RANK, AND AFSN

The base exchange officer at McGuire AFB, N. J., received a jolt through the mail recently.

An anonymous note arrived in his office with a dollar bill attached. The note read, "Dear Sir: This dollar is for one cup taken from a cafeteria two years ago."

The note and bill will be framed and posted in one of McGuire's exchange activities.

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OHM SWEET OHM

March AFB, Calif., electrified the usually well-insulated Departmental Editor with the following current item:

"Local electricians charge that they recently received a shock when a new airman was assigned to their section. His name—A/3C Richard K. Ohm.

"The Air Force, with its faculty for plugging airmen into the right job-sockets, made a glowing connection in assigning Airman Ohm to the preventive maintenance electrical shop of the 807th Installations Squadron."

THE AIRMAN has little resistance to such things. Watt about you?

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BITS OF BLUE

. . . Air Training Command headquarters is being reorganized to absorb the duties and functions of two subcommand headquarters which will close in the near future. Headquarters of the Flying Training and Technical Training Air Forces will both be discontinued later this year. Only the headquarters functions of the training air forces will be affected.

. . . ATC has also announced that several school courses will be shifted from Scott AFB, Ill., to Keesler AFB, Miss. The change will make additional space available at Scott to accommodate the recently transferred MATS headquarters.

. . . Meanwhile, USAF Hqs is planning for the mid-1958 inactivation of Manhattan AFS, N. Y., which currently processes USAF personnel being assigned to or returning from overseas assignments by way of the east coast. In the future, this processing is to be handled at the last home station or the port of entry.

. . . On May 7, SAC's Pinecastle AFB, Fla., will be renamed McCoy AFB, in honor of the late Col. Michael N. W. McCoy, former commander of the 321st Bombardment Wing of Pinecastle. Colonel McCoy died in a military aircraft accident in 1956.

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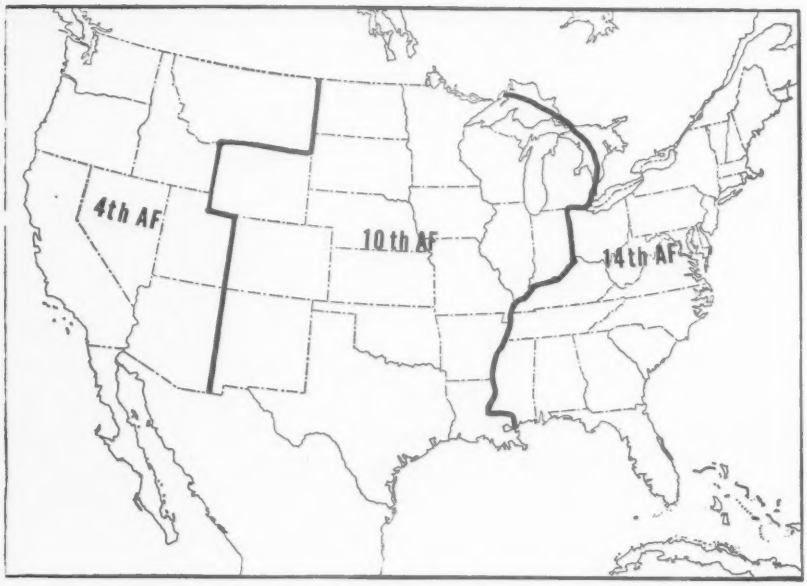
HUSTLING "HUSTLER"

What is probably the longest sustained supersonic flight by any aircraft—more than an hour and a half—was performed recently under test conditions by USAF's Convair B-58 *Hustler*.

Although the maximum speed of the supersonic bomber has never been announced, Air Force officials have released the information that it has been flown at a speed in excess of twice that of a .45 calibre bullet (1,130 m.p.h.).

Exhaustive test-flight programs have been devised for the delta-wing bomber, and it was on one of these that the aircraft performed its supersonic feat. On another mission in the same test series, the *Hustler* was flown for nearly six hours at speeds beyond the maximum capabilities of any other known bomber.



FAREWELL, FIRST

Effective July 1, Continental Air Command will realign their Reserve activities under revised areas.

First Air Force will be inactivated and 14th AF will absorb their present responsibilities in addition to the area they now serve. The states of New Mexico, Texas, Oklahoma, Louisiana, and Arkansas will be transferred to the expanded 10th AF area. The 4th AF will not be affected by the change.

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GET THE FACTS

All USAF bases are receiving revised editions of the *Career Fact Book*, a comprehensive report on the various aspects of an Air Force career for officer personnel.

The 48-page publication is divided into seven chapters, each dealing with a specific facet of career. DCS/Personnel officials at Hqs USAF have cited the fact that, to their knowledge, the information contained in the *Fact Book* is not presently available in any other single publication.

Subject matter treated in separate chapters consists of the Air Force future and mission, a discussion of the responsibilities an officer assumes upon receiving his commission, career and educational opportunities, and family living.

Mechanics and priorities of the assignment process are discussed in detail as well as a complete listing of pay scales and quarters and subsistence allowances.

Officers desiring to obtain copies of the publication for detailed study should contact the personnel officer at their base. The booklet was in distribution process at press time and should be available at most stations now or in the immediate future.

LINGUIST

To fill vacancies for FY 59, Air Intelligence Service has issued a call for officers proficient or desiring training in four foreign languages.

Applicants must be Regulars or Reserves on extended-active-duty tours who possess or desire training in Japanese, Russian, Spanish, or Tagalog. Experience in the intelligence field is an asset, but is not mandatory.

Officers who have an established separation date but who would extend if accepted for such an assignment may so indicate by submitting a specified time contract in accordance with AFR 53-11, para. 8a.

Other requirements mandatory to acceptance in this field include present assignment in the ZI and eligibility for foreign service; citizenship; not under consideration or having pending application for any other type of assignment or training; not serving in or possessing a limited resources specialty; not on a directed-duty tour; and if on flying status, requirements of the assignment and rotation policy outlined in AFR 36-3 must have been fulfilled.

Commissioned personnel meeting these minimum qualifications may ap-

WEARING TWO HATS

Performing duties as airpolicemen of the New York Air National Guard's 106th Fighter-Interceptor Wing comes natural for these men who are also members of the New York City Police Department.

Left to right are: A/1C John J. O'Flaherty, S/Sgt. John J. Waldron, Jr., S/Sgt. John D. Ritchie, A/1C Leon F. Bauer, A/1C Francis X. Barry, A/2C George Piciullo, and M/Sgt. Joseph J. Annunziato.

ply through normal command channels. Those possessing foreign language proficiency should indicate the degree of that proficiency in reading, writing, and speaking. Additionally, those seeking training should list a preference between two of the languages in which training is being offered.

Complete details of methods of application and extent of training are contained in a letter from DCS/Personnel, Hqs USAF (AFPMP-1-E-4A, datel 5 Feb. 58). Interested officers should contact the personnel officer at their home station.

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SNUFF IT OUT

A new publication, AFR 92-7, dated 4 February 1958, is on its way to all bases. It provides for selecting and honoring USAF installations having the most outstanding annual fire-protection programs.

The initial competition will cover fiscal year 1958. Major commands will select their three outstanding installations and report them to Hqs USAF—with justification—no later than August 31.

A perpetual trophy will be established and awarded annually to the winning base. The trophy will consist of a silver antique fire chief's trumpet mounted on a large plaque. Smaller plaques, for permanent retention, will also be awarded the first, second, and third place winners.

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RECORD YEAR

Civil Air Patrol pilots and aircraft flew more than 15,000 hours on search missions during 1957—an increase of more than 3,000 hours over the previous year—and were instrumental in saving 31 lives.

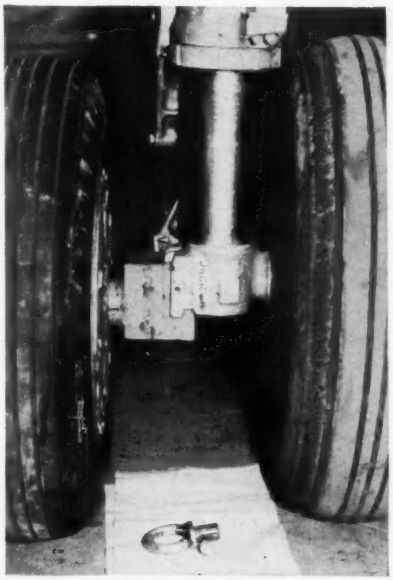
All told, CAP's 16,000 volunteer pilots participated in 176 search missions during the year. The missions included 33 for lost civil aircraft, 13 for military planes, and 22 for missing persons and boats.

Total cost to the taxpayer was approximately $36,000 for gas and oil—the sole cost to the government for these operations. All CAP aircraft are privately owned and their use is on a volunteer basis.

Maj. Gen. Walter R. Agee, USAF, national CAP commander, estimated that if the Air Force had to maintain a ready force of aircraft and rated officers on a basis similar to that of CAP, the total annual cost would be close to $20 million.

NEWCOMER

A new office, under the direction of DCS/Operations, will be established at Hqs USAF. The head of the office will fill the role of meteorological advisor to the Chief of Staff. To be known as the Office of Assistant for Weather the new function will be placed in operation some time between April 1 and June 30.



TIME OFF

In the December issue of THE AIRMAN, we reported on a device used at Wheelus AB, Tripoli, to expedite the clearance of damaged aircraft from active runways after minor accidents to landing gears or tires. (See *Accidents Will Happen*, Airman's World.)

Reports from Wethersfield AB, England indicate that airmen at that station have improved upon the original design. M/Sgt. Stanley Filipek and S/Sgt. Paul Simpson, 20th Fighter Bomber Wing, are responsible for the latest innovation.

Utilizing standard North American F-100 fighter parts, these two designed a combination axle-attaching plate and fitted it to the wheel and tire. By the simple expedient of removing the towing eye from the damaged strut and jacking the aircraft up, the towing dolly can be fitted into place and the plane towed off the blocked runway. Tests have proven the entire operation can be completed in less than nine minutes—a 25 percent improvement over the 12-minute average of Tripoli's dolly.

Additional features which speed the operation are: no attaching bolts or straps; machining the attaching plate to fit the F-100 strut with the weight of the aircraft providing positive engagement; and lifting the damaged wheel only an inch clear of the ground thereby eliminating difficulties in towing operations.

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NATIONAL CHAMP

One of the most sought after titles in baseball leagues the world over is the annual award for slugging; a measure of long ball hitting capabilities.

United States Air Force Academy first baseman, Cadet John Kuenzel, grabbed the National Collegiate Athletic Bureau crown with an average of .891, computed by dividing his 49 total bases by 55 appearances at bat.

Kuenzel also led the *Falcon* hitters with a .418 batting average, and in hits, runs, triples, homers, and runs batted in.

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CIVIL EMPLOYMENT

USAF commanders have been cautioned to inform all personnel of the limitations imposed on off-duty employment by current Air Force regulations and manuals.

Specifically, the governing publications are: AFR 30-30B, para. 8.3, dated 14 July 1955; AFR 190-21A, para. 15, dated 26 November 1957; and AFM 110-3, para. 50411.

With the wide variance in labor markets in different localities, part-time employment of Air Force personnel can be either a valuable service to a community or a distinct harm to USAF-civil community relations. Therefore, to allow commanders to weigh the relevant factors in the local situation, all personnel should obtain permission before accepting off-duty employment.

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NELLIS AND ATC

Airman's World item *Command Change* (February issue, THE AIRMAN) reported that Nellis AFB, Nev., was transferred from ATC to TAC. Only the Fighter Weapons School at Nellis was transferred to TAC's control. Combat crew training and jurisdiction of the base remain with ATC.

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POWER FOR PEACE

An official White House proclamation by President Dwight D. Eisenhower has designated the week of May 10 through 18 as Armed Forces Week.

Armed Forces Day will be observed on Saturday, May 17, and *Power for Peace* will again be the theme of the 9th annual celebration.

WELL, NERO FIDDLED

Nero fiddled while Rome burned, but M/Sgt. Lester James fiddles away his off-duty hours at a profit.

An instructor at the United States Air Force Academy, Sergeant James boasts violins as a hobby—both as collectors' items and as a product of his skilled workmanship.

It takes nearly 10 months for the talented sergeant to produce a final product. Hand carving each violin from open-air seasoned European wood, he finishes the basic instrument in approximately two months. The additional eight months—a period which varies slightly with atmospheric conditions—are required for the many coats of special varnish to dry. Many of his handmade models have sold for more than $500 each.

Unlike many modern violin makers, James shapes all his own neck pieces and each carries his distinctive scroll carved on the head of the neck. He also hand fashions the bows, stringing them with hairs—presently retailing for $40 a pound—from the tails of Siberian horses.

Within his private collection, James points with pride to his two oldest instruments, both manufactured in the 17th century. Others include one used by Polish nobility, manufactured in 1730, and another used by the famous European concert violinist, Lady Halle.

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AIR AGE LIBRARY

Man Unafraid, Stephen Tillman, (Army Times Publishing Co., $4.00). Colonel Tillman was at Fort Myer, Va., on Sept. 3, 1908 when the Wright brothers made their initial demonstration for the Army. His book is a month-by-month account of military aviation for the next eight years.

Five Down and Glory, Gene Gurney, (G. P. Putnam's Sons, $5.75). Traces the history of America's aces from World War I through the Korean conflict. Included is a listing of the aces of each war with a tabulation of their official records.

An Atlas of World Affairs, Andrew Boyd, (Frederick A. Praeger, $3.00). More than 70 maps and brief paragraphs of text explaining their significance have been compiled in one volume to provide thumbnail sketches and background of the spot news areas of the world.

FROM HERE AND THERE

. . . Funds in the amount of $23 million have been okayed for initial construction at R. I. Bong AFB, Wis. Bids for runway construction have already been advertised, and those for other long-lead-time items such as aprons and POL and primary utilities facilities will be advertised in the near future.

. . . The next Firepower Demonstration at Elgin AFB, Fla., is scheduled for May 6, with an alternate date of May 7 in the event of inclement weather.

. . . Traveling to Paris? Better check first. Latest information indicates a critical shortage of hotel space between April and October because of the Centennial Pilgrimage and the Brussels World's Fair.

AIRBORNE ABACUS

Tactical decisions will be virtually the lone responsibility of USAF jet interceptor pilots in the near future.

Hughes Aircraft Co. has perfected a miniaturized, airborne digital computer which can fly a jet interceptor through all phases of supersonic combat, from takeoff to touchdown.

Digitair, the trade name for the electronic marvel, is small enough to fit into the cabinet of a 21-inch table model television set and weighs a mere 120 pounds. Yet, it can make 9,600 arithmetical computations in one second and can render 6,250 decisions each minute. To draw a timely parallel, Hughes officials have stated that the

computer could perform the arithmetic required on all of New York State's 6.5 million tax returns in slightly more than 14 hours. The same job presently is estimated to take approximately 26 million man-hours.

John H. Rubel, Hughes' director of airborne systems labs, has stressed that Digitair can "effectively perform all necessary computing functions associated with flight, navigation, search, and attack in an interceptor mission, enabling the pilot to concentrate almost exclusively on vital tactical decisions."

Working with coded information flashed to it by ground control stations and the aircraft's own radar system, the electronic abacus can receive 61 different types of information and put out an additional 30, simultaneously. In the process it performs or monitors 16 separate navigational and flight control functions in less than two seconds.

Included are such operations as actuating the aircraft's control surfaces to correct pitch and roll; commanding the pilot to regulate his speed; maintaining a constant check on available fuel and the distance the plane can fly under existing conditions; and providing the pilot with information on target range, azimuth, and elevation. It also supplies a method whereby the pilot can maintain a constant check on his own accuracy and reliability.

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ECHOES OF SPAIN

Updating Maj. N. H. Traverso's story *Spain*, which appeared in the December 1957 edition of THE AIRMAN.

The article, *Spain*, inspired a torrent of requests for additional information about duty in the sunny land of olive groves and castanets. Here are some of the answers.

Uniforms

Military personnel arriving in Spain by military transportation (MATS or MSTS) will debark in uniform. When commercial surface transport is used, civilian clothing will be worn. Whenever practical, civilian clothing will be worn by those arriving via commercial air.

Organizations located on U. S. bases in Spain require the wearing of the uniform during duty hours. After duty hours, the uniform may be worn on the base or in the course of travel to off-base housing. The uniform is *not* worn off the base in public places such as restaurants, theaters, or churches.

In case personnel are required to perform duty away from the base civilian clothing is authorized, and is usually worn as a matter of preference. Nothing prohibits wearing of the uniform in these circumstances, and it is, in fact, required on certain occasions. There is no provision for an extra monetary allowance for civilian clothing, and all airmen must be in possession of the usual items of mandatory clothing and accessories.

Quarters

While a broad program of private construction is underway in the vicinity of the bases in Spain, government quarters as such are listed as "not available." Apartments and houses on the local economy are described as comfortable, but architectural style and facilities may differ somewhat from American custom. Dwellings are usually equipped with a two-burner gas range with oven for cooking, and a coal stove for heat. Military families will require refrigerators, appliances, bedding, kitchenware, etc.

On shipping household goods overseas, however, it is well to remember that the rooms of your castle in Spain may be quite smaller than those for which your furniture was designed. Major appliances, such as refrigerators, can be purchased after arrival overseas, and the selection of a suitable model may be simpler after viewing the premises to be occupied. Any standard American electric refrigerator can, of course, be used.

Electricity is described as 110-125V, 50 cycle and 210-230V, 50 cycle. The newly arrived householder will do well to check the voltage carefully before plugging in expensive appliances. Fluctuations in the current supply may cause occasional minor annoyances, and the record player will turn a bit slower on the 50-cycle power. Transformers are available so that small American 110V appliances may be operated from the 220V circuits. Wall plugs are of the European variety. This means that the plug on your American radio or toaster will not fit into the receptacle no matter how hard you try. Converters to correct this are readily available at very modest cost.

Commissaries and BXs

Commissaries are in operation at the three main centers of military population, Saragossa, Madrid, and Seville. The largest is at Madrid. All are well stocked. Persons stationed at isolated installations may have to depend entirely on local civilian sources of supply.

The Air Force Exchange Service (AFEX) operates base exchanges at each military installation. In addition to the usual items the outlets in Spain offer an interesting and useful selection of European merchandise. American-made clothing is available with some limitations as to style and sizes, but formal attire is not included. Ladies who wear shoes in sizes other than A, B, or C widths are advised to make mail-order arrangements before leaving the U. S. All exchanges operate a special-order department.

Extreme styles or conspicuous attire are not recommended for adults. AFEX stores carry a reasonable supply of children's clothing, which can be supplemented from the local civilian market. While the Spanish peninsula is on the same parallel of latitude as New York, the climate is moderate and is classed as subtropical in the south.

Autos

Privately owned automobiles may be shipped to Spain. Liability insurance is mandatory and reputable European insurance companies offer coverage at prices comparable to those prevailing in the United States. Before vehicles can be operated in Spain, proof of insurance must be presented.

Gasoline is not rationed in Spain and military personnel may purchase coupon books negotiable for gas and oil at stations operated by AFEX. The price is slightly less than in the United States. Civilian gasoline stations—at which purchases may be made only with Spanish money—are not numerous, but adequate. Gasoline on the civilian market is expensive.

Automobile accessories such as wiper blades, fan belts, spark plugs, etc., can be found at exchanges, but major parts must be "special ordered" with delivery time stretching sometimes into extended periods of inconvenience. The prospective *voyageur* is advised to have his car in tip-top condition before delivery to the POE. Exhaust systems deteriorate fast in western Europe's climate.

Highways in Spain are narrow, twisting, and often dangerous because of heavy animal traffic.

The Spaniards are a proud and hospitable people, and the country is endowed with a wealth of culture and tradition. Assignment to Spain can be considered good duty.

A PAGE FROM THE PAST

A page from the Air Force past reveals that spring is a time for history making.

GERONIMO

The little acorn from which grew today's mass paratroop jumps was planted at Mather Field, Calif., on March 9, 1921. Five men jumped from a DH-4 flying at 2,100 feet. Lt. Eugene Batten, in the rear cockpit, directed the jumps by four airmen—one from each of the wing sections—and then jumped himself. All five reached the ground together.

Seven years later five men made simultaneous jumps from five aircraft at Brooks Field, Tex. As soon as this quintet landed, a Martin bomber paradropped a machinegun which the five set up and fired within three minutes.

Air Corps Newsletters, Apr. 1, 1921
Nov. 24, 1928

SPRING THAW

In the spring of 1920 the usual thaws brought high water and flooding along the Miami River valley at Dayton, Ohio. Air Service planes from McCook Field made numerous flights over the flooded areas for the purpose of taking pictures. Permission was given the local newspapers to publish some of these, creating widespread interest in the use of the airplane. The "recon" pilots reported that it would have been easy to drop packages of food to isolated sections in case such action would have become necessary.

Air Service Newsletter, May 10, 1920

FOLLOW THE LEADER

On a pleasant spring day in March, 1931 at Kelly Field, Tex., the senior instructor in pursuit flying at the Advanced Flying School took up a flight of seven students for instruction. After maneuvering for some time he signaled for a landing. At debriefing, he chided the students in no uncertain language because they neglected to follow him through all the maneuvers. He made it plain that in the future they were to stay with him no matter what happened.

Back in his ship, he again led the students into the air. The instructor had barely climbed 100 feet when his motor quit cold, and he signaled wildly for the formation to break up as he glided down for a forced-landing. But the students, with the recent lecture firmly in mind, stuck close by. All seven landed alongside him in the open field.

Air Corps Newsletter, Mar. 19, 1931

TALKIES

In the spring of 1930 Langley Field, Va., became the first post to show a "talkie movie." During March of that year the post theater—a converted hangar—scheduled a different all-talking program each night.

Air Corps Newsletter Mar. 5, 1930

COME AND GET IT

In April, 1930 airmen at Maxwell Field, Ala., became the first to enjoy cafeteria-style mess halls. One end of a squadron barracks was modified to accommodate 130 diners. Dining room orderlies, the open hole table covering refuse cans, and many other familiar mess hall sights originated at Maxwell.

Air Corps Newsletter, April 10, 1930

ABOVE AND BEYOND . . .

Airmen appreciate the airplane's potential in peace and war and as early as the 1920s, they recognized the danger of a crash in populated communities. Then as today, they instinctively guided disabled craft to the "wide open spaces."

The record proves it's always been that way. On April 16, 1927, Lt. E. H. Tonkin was making a routine flight in a DH-4 from Washington, D. C. to Wright Field, near Dayton, Ohio. Over the city of Springfield, Ohio, an engine connecting rod broke and punched a large hole in the crankcase. Ignited gasoline and oil spouted out, throwing flames over the plane, the cockpit, and Lt. Tonkin.

Afterwards, Tonkin stated that he had utter confidence in his parachute and had considered jumping, but realized that the burning plane might crash in the city. Therefore, he decided to stay with the plane, gliding it to an open field at the edge of the city where he made a crash-landing. Because of the extremely rough ground, the plane was badly damaged. The pilot, who jumped out and extinguished the fire by rubbing his gloves along the burning fabric of the fuselage, suffered burned hands.

The Hon. Dwight F. Davis, Secretary of War at that time, wrote the officer: "It is my desire to commend you on your judgment and coolness in this trying situation and to assure you that your action is worthy of the highest tradition of the Air Corps."

Air Corps Newsletter, April 26, 1927

QUEEN OF THE HEAVIES

by T/Sgt. Harold L. Craven
Airman Staff

Our newest and most capable heavy transport, the Douglas C-133A, can airlift any existing U. S. surface-to-surface missile. Its ability to move outsize equipment to any point on the globe in a matter of hours greatly increases the effectiveness of our overseas bases.

TRANSPORTING an *Atlas* ICBM from San Diego to Cape Canaveral was a project of major proportions last year. The missile was hauled overland on an outsize, specially built trailer. The trip required two weeks time and a crew of more than a dozen men. Moving an ICBM from California factory to Florida launching site is still a big job, but five men and the Air Force's newest giant transport plane can, if necessary, do it any morning between breakfast and lunch.

The new queen of heavyweight transports is the Douglas C-133A, a 30,000 h.p. turboprop freighter now being used by the Military Air Transport Service. It's a long-range, high wing, high performance airplane capable of carrying all current intermediate range and intercontinental ballistic missiles and their supporting equipment. It can also accommodate 96 percent of the vehicles used by our ground forces, fully assembled, and deliver them to any U. S. base in the world in a matter of hours.

Because of its ability to move the weapons of today and tomorrow to any part of the world, the effectiveness of our overseas bases is increased. With this plane, movement of heavy payloads on long-haul operations can be accomplished with far less flight and maintenance personnel per ton-mile than with any other cargo aircraft now in service. Addition of the C-133A to the MATS transport fleet will permit the retirement of second-line aircraft such as the C-54 which are less productive because of higher ton-mile costs.

Atlantic Division, MATS, is now using the first of its new turboprop

transports on flights between Dover AFB, Del., and Chateauroux, France, with enroute stops at Harmon Air Base, Newfoundland, or Lages Air Base, Azores. First squadron to begin receiving the new planes was Dover's 39th ATS. A Pacific Division squadron is second on the delivery list and will use C-133As between Travis AFB, Calif., and Tachikawa, Japan. Enroute stops are to be made at Wake or Midway Islands.

Wingspan of the new sky freighter is 179 feet 8 inches. Its fuselage is more than 157 feet long and the uppermost portion of its vertical stabilizer measures more than 48 feet from the parking apron. Empty weight is 116,191 pounds. Maximum gross takeoff weight is 282,000 pounds.

Integral fuel tanks, which permit rapid single-point refueling, hold 18,112 gallons of JP-4. Refueling time is approximately 30 minutes. Range with a 50,000-pound payload is in the neighborhood of 3,500 nautical miles; with 100,000 pounds of cargo, more than 1,000 nautical miles. Two C-133As can haul as much cargo as five C-124 *Globemasters*, and seven of the new planes have the same cargo carrying capability as one liberty ship.

Cargo space is fully pressurized. Gas turbine units enclosed in the main landing gear fairings provide a cabin pressure of 10,000 feet maintainable at 35,000 feet. Although the plane was designed primarily to haul freight, it also has a troop carrying potential. Complete fuselage pressurization would permit high-altitude operation with troops aboard.

Two loading doors provide access to a 90-foot long cargo compartment, permitting simultaneous front and rear loading. The cabin floor is at truck-bed height. A hydraulically powered loading ramp built into the rear cargo door can be raised off the ground with a 10,000-pound load and is capable of supporting 25,000 pounds in a horizontal position. It can be adjusted to various truck- and trailer-bed heights. The rear door is large enough to permit loading of a 12-foot high item onto the 142-inch wide floor. Front loading is accomplished through another doorway on the left side of the aircraft. This opening, 100 inches high by 106 inches wide, will permit loading directly from a truck or trailer. Forklifts can be used inside the cargo compartment to speed loading and offloading.

Two loading doors permit simultaneous front and rear loading into 90-foot long cargo compartment.

Unloading heavy vehicles from older, high-bed transports like this C-54 was a slow, difficult task.

Lightweight roller conveyor system speeds cargo handling.

Cargo-handling time can also be reduced by means of a rapid loading and tiedown system consisting of large panels for unitizing the load, lightweight roller conveyer sections, and nets. This permits preloading of cargo on as many as nine pallets which can be moved manually along the rollers into the plane and to their proper positions inside the compartment.

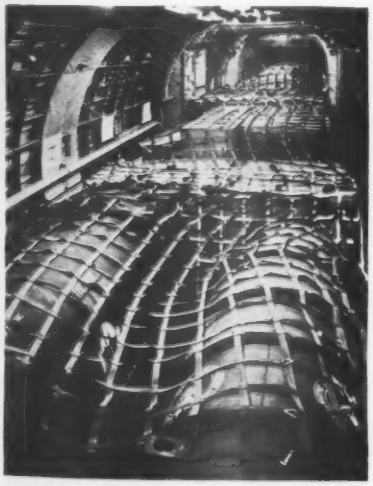
The conveyer system can be installed by four men in six minutes and removed in four minutes. It permits six men to load and secure a 67,000-pound load, consisting of a wing panel, engines, a truck cab, a

hydraulic check stand, and miscellaneous items, in about 40 minutes, a feat which would have been impossible with previous cargo-handling methods.

Once aboard, the cargo is held in place by a net tiedown system consisting of six cargo nets for vertical and lateral restraint and six barrier nets for forward and aft restraint. The nets, which weigh a total of 1,020 pounds, are suspended along the right side of the cargo compartment when not in use.

The forward upper portion of the fuselage contains the flight deck where stations for pilot, co-pilot, navigator, and systems engineer are located. Sleeping accommodations are provided for three relief crewmembers immediately behind the flight deck. Normally an assistant systems engineer will round out the five-man flight crew.

Detail engineering on the C-133 was begun in 1953 and the first plane made its initial test flight in April 1956. Initial testing of a newly designed plane usually consists of brief flights followed by extended periods of ground time during which various mechanical or design "bugs" are eliminated. The new Douglas plane was an exception, so well engineered that test pilots were able to log 33 flying hours during the first 30 days, a record for the first plane of any Douglas model. In January 1957 three of the huge cargo planes were undergoing tests at Edwards AFB, Calif., and a fourth had been flown to Wright-Patterson AFB, Ohio, for climatic tests. MATS began flying the Atlantic with C-133As in January of this year.



Typical MATS load can be put aboard and secured in 40 minutes.

Atlantic Division's 39th ATS got the first of the new heavies.

Two Dover-based C-133As, commanded by Col. Claude W. Smith and Maj. William R. Stanton, carried 20 tons of high-priority cargo on their record-breaking maiden overseas flights to Chateauroux. Elapsed times for the flights were 10 hours 21 minutes and 10 hours 29 minutes, without enroute stops or aerial refueling. Flying over the great circle route the planes attained speeds in excess of 400 m.p.h. and operated at altitudes above 20,000 feet for most of the flight. Upon their arrival in France, Colonel Smith reported that one of the planes had attained a top ground speed of 470 m.p.h. and that the flights were "routine and marked with complete absence of maintenance problems."

Douglas officials report that "it has been estimated that cruise speeds for C-133A long-range operation exceed the maximum level flight speed of most World War II-type propeller-driven fighters." Despite its size, weight-carrying ability, speed, and long-range capabilities, it can operate from existing air bases or, if need be, polar ice strips. It's a go-anywhere airplane.

According to Lt. Gen. Joseph Smith, commander of the Military Air Transport Service, the C-133 is an aircraft tailored to the guided-missile age.

"It brings MATS up-to-date with the latest in cargo transport equipment. Its range, which permits nonstop overseas service, eliminates the need for intermediate stops which generate maintenance and service delays. Its great capacity permits the carrying of strategic cargo such as missiles and their associated equipment. . .

"In the event of aggression," General Smith continued, "the ready and prompt ability to place troops, supplies, and outsize equipment anywhere in the world in support of the 'strike forces' may well be a vital factor. Such a concept, which demands modernization with the latest technological advancements, was responsible for the development of the C-133.

"Not only will the C-133 provide the Department of Defense with more vitally needed airlift, it will enhance MATS' flexibility to fulfill, with a lesser number of cargo transports, its basic D-day combat mission."

Toward Better Base-Community Relations

by Dr. Thomas F. Staton

Educational Advisor
Air Command and Staff College

A BASE COMMANDER was griping. "I've done everything they say to do to cultivate good community relations, and I don't feel like I've accomplished a doggone thing. I've had luncheons for the mayor and city bigwigs, I've held open house for the civilian community, and we've bombarded the newspapers with editorials on why we are here, what airpower means to America, and interesting news about happenings on the base. Everything!"

"Having trouble?" I asked.

"No," he replied, "Not really. There's no friction that I know of, no fights or protests. But somehow we just don't seem to be *in* the community. They accept us in a courteous, impersonal way . . . then ignore us. It's like talking to a cordial, polite person . . . through a closed screen door."

"That's not what I want!" he continued. "Airmen are Americans, living in American communities. I want those at my base to be part of those communities, not homeless boarders!"

That base commander was probing deep, seeking the real heart of good community relations. He wasn't satisfied with the stiff, artificial, feed-the-mayor approach. Neither was he contented with the get-space-in-the-newspaper (or advertising agency) approach, or the open house (step-right-up-and-see-the-show) approach. All of them are good, all serve useful purposes, but none gave what he wanted—acceptance of airmen as a segment of the community just like Kiwanians or Presbyterians, and warm, friendly human relations between the townspeople and the airmen.

This is the community attitude that makes the Air Force a pleasant career for airmen, an Air Force base a prized element of a community, and airpower an honored and appreciated concept in the minds of civilian America. It is the sort of base-community relations that exist in some localities, and can be cultivated in any locality by conscientious and well-directed effort.

Good base-community relations are a three-legged stool. The legs are (1) a public education program involving civic luncheons, newspaper articles, and open-house days on the base. This is by far the best known, most widely used, and simplest of the three supports, and will not be discussed here. The other legs are (2) military-civilian cooperation in the civilian community, and (3) support of the Air Force by its civilian employees who live in the community.

This nature of the foundation of good community relations is why community relations are the business of everyone in the Air Force, not just the business of the base commander and the top staff. Good community relations are a matter of *climate*, of a tangible feeling of good will between families whose head wears a uniform and families who are all in civilian clothes. They are a matter of young men in uniform being regarded as boys from the house next door, not as suspicious transients. These feelings, welling from deep within the lives and minds of the civilian element of the community, don't come from dinners for city officials, newspaper releases, and open houses; they come from airmen and Air Force families living and acting among the civilians like the families and boys next door. Such deep, fine human relationships come from the rank and file, the mass, of civilians and Air Force people living and working together. There's no window-dressing that will substitute for it, and no way the base commander can accomplish it personally. He can encourage his people to cultivate good base-community relations. He can't do it by himself.

The people living in town have a real opportunity. They are the ones who have the opportunity of being known as good neighbors. They are the ones who can give a hand when workers are needed in the Community Chest drive. They can be the stalwarts to whom the PTA looks to keep the parent-school cooperation healthy and prosperous. They can be the ones whom parents in the community think of not as some strangers who are temporarily here from Tokyo, but as "Betty's Sunday School teacher" and "Edgar's Scoutmaster," and "the mother who drives the children in the car pool to school on Wednesdays." They can be the ones who helped on the garden club community clean-up campaign, and the church every-member canvass.

Little things? Not to a community. If you stop to think about it, these "little things,"—or the lack of them —determine whether or not a community is one in which you want to live and raise your children. You wouldn't want to live in a dirty, run-down community, without churches, where no one was interested in what happened to the school, where there was no provision for supervised social life for your children, and where the needy had to depend on begging for their subsistence. Some one has to do the myriad of things necessary to community life and progress. If Air Force families in a community are active in helping do them, the Air Force will be regarded by that community as a fine and valued asset.

From this, it is apparent that the element of the military community that is most influential in determining the quality of base-community relations is the segment that lives in town. The ones living on the base, doing nothing in the community (except occasionally visiting the country club and parties) and contributing nothing to the community except the money they spend, tend to be evaluated in terms of what they contribute: money. This is not a criticism or reflection on base-living personnel. It is simply that making a contribution to the civilian community is harder for them, and requires more effort and ingenuity. Through schools and churches, however, they have a fine opportunity to link the base with the civilian community. In fact, almost all the ways just suggested for in-town families are open to on-the-base families as well. Exploiting these opportunities is time and energy well spent if people living on a base want their base personnel to enjoy good community relations.

Single airmen are one of the crucial problems in base-community relations. With them, the techniques must be different, but the principle is the same. If airmen contact with the civilian community is characterized by active participation in local churches and their programs, by spending some time (as required by courtesy) visiting and talking with the parents of girls they date, and by going with the girls they date to the youth activities sponsored by the community, they will be accepted and respected as desirable members of the community's young society.

If airmen contacts with the community are characterized by behavior that the better element of the community regards as delinquent when engaged in by civilian boys, they will be regarded, as a class, as delinquents. Parents and nice girls will shun them, and the airmen will say the community is down on servicemen.

Commanders can't make airmen behave toward the community in such a way as to be accepted as normal, wholesome "boys from next door." But if they really value their base-community relations, they'll try! That is part of what character guidance type programs are (or should be!) for. But in the last analysis, as in the case of families, the Air Force's reputation in the community rests in the hands of the Air Force personnel *as a mass.* If the unmarried airmen act like responsible young gentlemen of good character in the community, the base-community relations (as far as they are concerned) will quickly become good. There'll be nice girls to date and parents will make them welcome. If they act like bums, rowdies, juke-joint cowboys and toughs, parents will resent them, most girls will shun them, civilian boys will fight them, and base-community relations will be bad.

So far we've talked about the advertising campaign type of community relations program and the military personnel community relations programs. There is a third leg of a base-community relations program. It is rarely exploited. In fact, on most bases it is almost completely ignored. And through ignoring it, Air Force officers and noncommissioned officers are every day sacrificing one of the areas of greatest potential for cultivating not only better base-community relations but for cultivating good public relations for the Air Force generally.

This neglected area is the community relations potential of the civilian employees of Air Force bases.

The average Air Force base employs several hundred civilians who are respected, established citizens of the civilian community in which the base is located. Many are influential persons in their churches and communities. Furthermore, they are brothers, sisters, sons, daughters, wives, and relatives of local businessmen, politicians, and journalists. The things these employees say to their friends, relatives, and neigh-

The people of the Air Force—military and civilian—leave the base at the end of the day. Each exerts an influence in his community. Each is a force for good community relations; but it is a force which must be set in motion.

bors exert more influence on a base's community relations than reams of news releases and similar public relations activities.

Any community will think highly of its Air Force citizens and base if several hundred of its responsible members who work at the base are enthusiastic Air Force boosters. No base-community relations program, on the other hand, is good enough to make the Air Force popular with a community if the hundreds of community residents who work for the Air Force are antagonistic, or even apathetic, about the Air Force personnel for and with whom they work. And when you total up the population of all the communities of the United States which are influenced by residents who are employed by the Air Force you have an enormous segment of the Nation's public opinion.

So to round out an ideal community relations program, make an Air Force booster and public relations agent out of every civilian employee. Such a result would be worth sacrificing a little civilian work turnout, but the nice thing is (and this has been conclusively proven dozens of times over by business and industry) that the moves necessary to turn civilian employees into Air Force boosters actually result, as bonus benefits, in more work done better, lower turnover, and greater loyalty. It's the well-understood principle that knowledgeable, proud, enthusiastic members of an organization do more and better work than resentful, unhappy wage-slaves.

The following practices will help develop civilian employees into enthusiastic, loyal, knowledgeable Air Force boosters:

1. Through briefings and films, keep civilian employees informed on Air Force and airpower matters, such as history, plans, hopes, fears, problems, equipment, and needs. Educate them so they can talk Air Force convincingly to their acquaintances and relatives on matters where public opinion is important to the Air Force. Having such knowledge helps make them feel they are a part of the Air Force team—and to be proud of it. It also has an important effect on community attitudes and Air Force public relations.

2. Explain the "whys" of things to them, from the "why" of reorganization (and maybe the impracticality of granting some of their preferences) to the "why" of an SOP. Your time and trouble will be repaid by their better work. (The fact that they will tell acquaintances that the Air Force ways of doing things make sense instead of grumbling that the military are incompetent bunglers will be pure bonus for your public relations program.)

3. Establish a Civilian Employees' Council, with members elected by the employees to meet with the commander at regularly scheduled intervals to discuss policies and problems. (This idea can be profitably used by any officer or noncommissioned officer who has a number of civilians working under him.) Such a council, if intelligently used, will raise morale, decrease problems, and assist the commander in many ways.

These are the three legs to the stool of base-community relations. The first, easiest to construct, most common, and least important is the public information, or "advertising," leg. A more important leg, more difficult to construct but infinitely more valuable to base-community relations, is Air Force personnel making themselves valuable and valued participants in the life of the community where they live. The third leg, fully as essential as the second (and, in addition to its community relations contribution, a leg that will give the Air Force much better work and cooperation from its civilians) is the leg of identification with and enthusiastic support of the Air Force by civilian employees.

Are you doing your part to build all three legs, or is your portion of the base-community relations program teetering unsteadily on two, one—or none?

EVER SINCE that day in 1678 when the British army assigned six oboes to the Horse Grenadiers, music and the military have gone together like ham and eggs.

At the Battle of Waterloo, when the Forty-second Highlanders were wavering under Napoleon's attacks, Wellington ordered the pipers to play as they had never played before. The bagpipes stirred the Scots to such renewed energy and fighting spirit that they rallied, and the Allies were able to press on to victory.

Today's military band has a different purpose. Instead of inspiring troops to fight, it's designed primarily to improve morale. Far removed from the concert-in-the-park type music usually associated with military bands, it must be able to ring the changes on a wide repertory; play Sousa and Pryor, gentle Mozart or super-charged jazz, rock 'n' roll, or Rimsky-Korsakoff with equal finesse.

A fine example is the United States Air Force Band. Youngest of the service bands, it actually has two missions: improving morale at Air Force bases, and helping create a better understanding between the U.S. and the peoples of the world by giving them a firsthand insight into American culture. In eight tours to 37 principal cities of four continents, the band has played before a heterogeneous 16 million people.

Last summer 75 of the band's airmen-musicians, directed by Col. George S. Howard, made their second good will tour of the Far East, including Air Force bases and adjacent communities. Purpose of the tour: to improve morale at FEAF bases; better relations between servicemen and local people; and generally create good will toward and understanding of the U.S. The band more than fulfilled its mission.

THE USAF BAND

Colonel Howard (second from left) goes over plans for 1957 FEAF good will tour with three members of his staff. From left: Capt. John F. Yesulaitis, Capt. Robert L. Landers, and 1st Lt. Harry H. Meuser.

Ambassadors of Good Will

by Dave Karten

"The United States Air Force Band has brought the hearts of our nations closer together."

Thus commented Mayor Tadao Watanabe of Hiroshima, Japan, following the April 21, 1956 concert of the Unitd States Air Force Symphonic Band, midway in its seventh postwar good will tour abroad. Sponsored by the State Department, the tours have won popular, official, and critical acclaim nothing short of spectacular. A record 200,000 people filled Manila's Luneta Park to hear the Air Force's Ambassadors in Blue.

In Kyoto, cultural center of Japan, 20,000 music lovers crowded into a concert site built to hold 5,000 people. Serious injury was averted only after the mayor got up on the stage and announced that several thousand persons would have to leave before the concert could begin.

In Tokyo, scalpers somehow got hold of the free tickets to the Air Force Band concert; sold them outside the sports arena for 1,500 yen ($4.50 in our money).

In Berlin and Heidelberg, on a previous tour, civic authorities estimated the American musicians attracted greater crowds than Hitler rallies in Nazism's palmiest days. In the former German capital's Funkturm Gardens 35,000 music lovers sat in a driving rainstorm two hours to hear the band while 6,000 others stood outside the gates. In the city's Olympic Stadium, the band attracted 130,000 people. An additional 50,000 had to be turned away due to lack of space.

In Vienna, their appearance caused the biggest sensation since Johann Strauss. Thirty thousand Viennese stood four hours to hear the Air Force musicians. At the concert's conclusion, they lined the streets for blocks to individually thank and salute the band members as they rode by on their way to their quarters.

The Oberburgermeister of Heidelberg voiced the reaction the band has met from Beirut to Bangkok, from Bodo to Saigon, when he said, "In your music you speak a language we all understand."

However, the band's reception hasn't always been a cordial one. When it arrived in the French city of Evereux on July 7, 1954, during its fourth good will tour abroad. bandsmen were greeted with Communist-distributed handbills reading "No music, go home!" Communist strategy backfired. Instead of keeping people away, the handbills attracted an enthusiastic capacity audience that stayed for encore after encore.

Col. George S. Howard, conductor of the band and director of Air Force musical activities, believes the band's success can be attributed to its versatility—ability to play like a military band, a symphony orchestra, or a jazz band, with equal virtuosity and switch from symphony to popular music without a tremor. "Most of the credit," Colonel Howard points out, "belongs to the professional artistry of the individual bandsmen. They have time and again come through with flawless performances while playing under almost impossible circumstances. Despite illness, bad accommodations in remote cities of the world, rushed packing, poor meals, unfavorable weather, or long, noisy flights, they've never permitted personal discomfort to interfere with the quality of their performance.

"We played a concert in North

The band travels in various type military transport planes. On eight tours to 37 principal cities of four continents, they have played before an estimated 16 million people.

Three bandsmen take time out for sightseeing in Hiroshima. (L to r) M/Sgt. Robert Moore, percussionist, Capt. Robert L. Landers, director of the Singing Sergeants, and T/Sgt. Jay Haunstein, clarinetist.

T/Sgt. Philip Young, harpist, was one of the featured soloists on the Air Force Band's FEAF tour.

Africa when 14 band members were so ill they could hardly manage to climb up on the stage. We have been drenched by driving rain, played with umbrellas over us because of the oppressive sun, and with overcoats on because of extreme cold in unheated halls. We even had to play concerts from memory due to high winds that made it impossible to keep sheet music on the stands. We've played to audiences that were hostile to both the Air Force and the band at the outset of the concert. To watch their reaction as they were won over to our side was always a great satisfaction."

After a modest beginning as a saxophone quartet in 1942, the band grew to a 100-piece symphonic musical organization which entertained thousands of troops during World War II.

During a concert in the English city of St. Edmunds toward the close of World War II, M/Sgt. Gordon Pulis, now first trombonist with the New York Philharmonic Orchestra, launched into a cadenza from Arthur Pryor's "Thoughts of Love." As if on cue, the opposite side of the street got a combination of low-level bombing and strafing.

"The soloist finished his part," Colonel Howard reports, "before rushing for shelter. It was the fastest cadenza on record!"

In 1945, rapid demobilization reduced the band to a total of five musicians. Colonel Howard himself planned to leave the service to direct music at Penn State University, but was persuaded to stay in uniform and assume the task of rebuilding the band. Within two years, from

Pretty Japanese girl presents Colonel Howard with bouquet of flowers upon band's arrival at Tokyo International Airport.

Air Force volunteers, he developed a 100-member military band on a par with the wartime version.

Over 1,400 professional musicians were auditioned in selecting its 100 artists. Those chosen came from a wide variety of musical organizations ranging from the Honolulu Symphony to the late Tommy Dorsey's dance band and Arthur Pryor's band.

The present Air Force Band can resolve itself into a 100-piece marching band, a 90-piece symphony orchestra, an 85-piece symphonic band, a 25-man glee club (The Singing Sergeants), five dance bands, and numerous instrumental groups and ensembles.

With 20 clarinets taking the place of violins, with bass viols and cellos to soften the metallic edges of the brasses, the symphonic band has drawn plaudits from popular as well as classical musicians during overseas tours. "In its music," wrote critic Marcel Grilli of Tokyo's Nippon Times, "the Air Force Band is a far cry from such stalwarts as John Philip Sousa and Arthur Pryor. From romantic music to jazz and from operatic arias to folk songs, this band can elicit the special flavor of musical style." And English opera singer Maggye Teyte, exclaimed, "I listened for a half hour before I realized the band didn't have any violins."

At its Bolling AFB Headquarters, in Washington, D.C., or on tour in this country or abroad, the band practices from four to six hours at a stretch. Practice goes both by the band as a unit and by separate sections with an unheard of variety in repertory to keep the band members from going stale. After hours, instrumentalists relax with more individual and combination practice.

"Every bandsman, aside from being a free-born or naturalized American, feels he has a creative part in the band," Colonel Howard explains. "We encourage each member to speak out, criticize, and submit ideas on how a selection should be played. If it's good, we incorporate it in the arrangement. Practically every man has at some time or other been able to improve our performance in this way."

Brass section swings out during jazz novelty number. Band concerts are arranged to satisfy every musical appetite from symphony to popular.

As one significant dividend of the policy, the bandsmen furnish their own instruments, valued at more than $500,000. Use of these fine instruments, rather than government issue, is another factor that helps account for the high quality of the performances.

On its 1957 FEAF tour, from Tokyo to Hongkong, the band played local favorites, rousing marches and folksongs, along with American popular music and traditional songs. Most concerts were free. Where admission was charged, the proceeds went to benefit the Orphan's Fund or some local hospital.

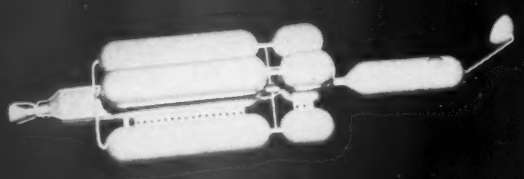
"Far East audiences," Colonel Howard explains, "will recognize that we enjoy their songs as much as they do. By touching and briefly sharing in their lives through the universal language of music we can cement better understanding between our people and theirs and increase the stature of our United States Air Force personnel abroad."

Capacity crowd jammed every inch of available space during concert in the Place des Invalides, Paris, France, and cheered the band for encore after encore.

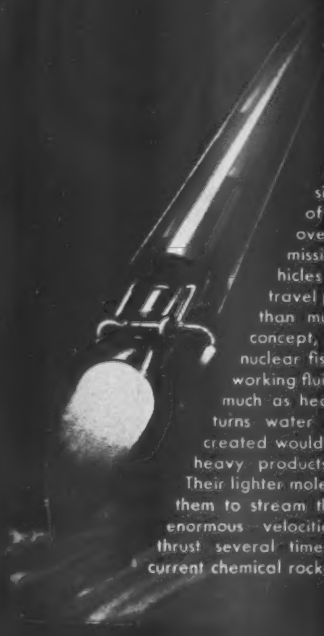
SPACE PLANES?

Here are artists' concepts and models of craft designed for space flight beyond the earth's gravity and atmosphere

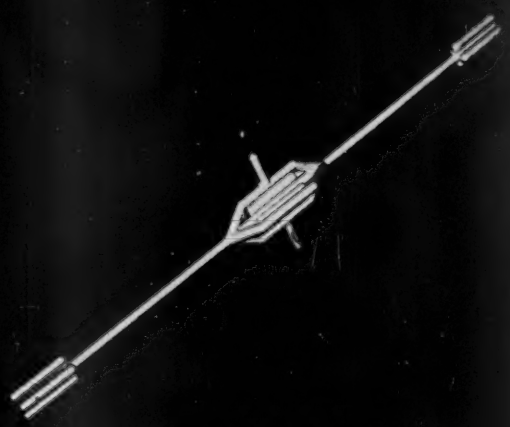
The *Moon Ship* was designed by Convair for exploration trips around the moon. It is composed mainly of a cluster of chemical fuel tanks. From the cluster projects a cylindrical crew cabin (at right), tipped with a parabolic radar antenna. The interplanetary space ship has its cabin well separated from the radioactive atomic-reactor ion engine, which is at the ship's tail (left) surrounded by the group of five fuel tanks.



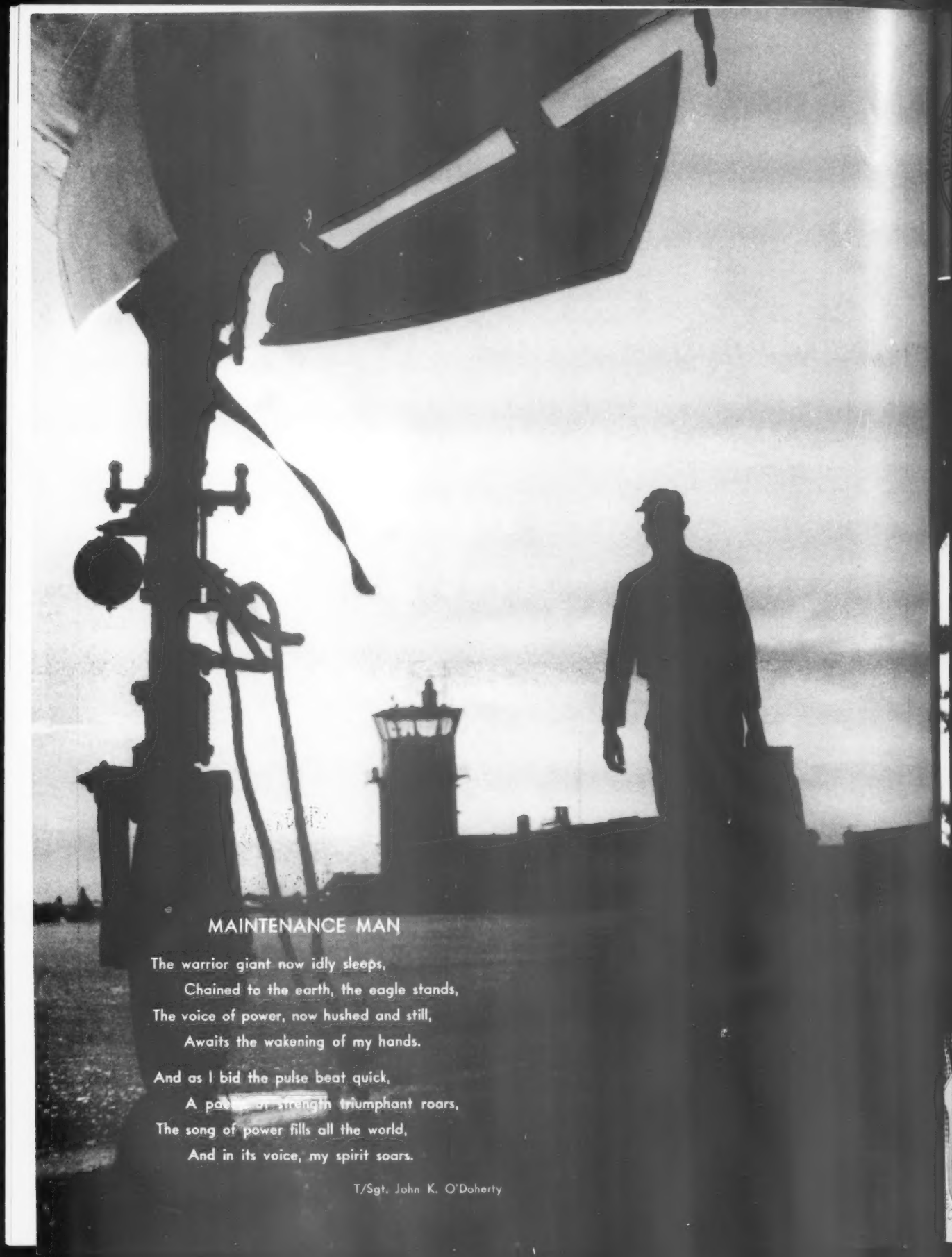
An artist's concept of the Goodyear-designed *Meteor Jr.*, a minimum size three-stage ferry rocket vehicle, approaching the moon for a landing. Its prospective uses: a research test vehicle; an unmanned satellite for communications, observation, and scientific study; a temporary manned earth satellite; a basic unit for permanent orbital terminal in space; or a vehicle to supply and man a satellite or orbital terminal.



An artist's concept of a North American *Rocketdyne* nuclear rocket missile. Theoretically capable of hundredfold increases over payloads of today's missiles, nuclear-rocket vehicles may make interplanetary travel possible with single rather than multistage powerplants. In concept, this engine would use nuclear fission energy to convert a working fluid into propulsive gases—much as heat from an electric plate turns water into steam. Gases thus created would be free of the relatively heavy products of normal combustion. Their lighter molecular weight would allow them to stream through rocket nozzles at enormous velocities, creating propulsive thrust several times greater than that of current chemical rockets.

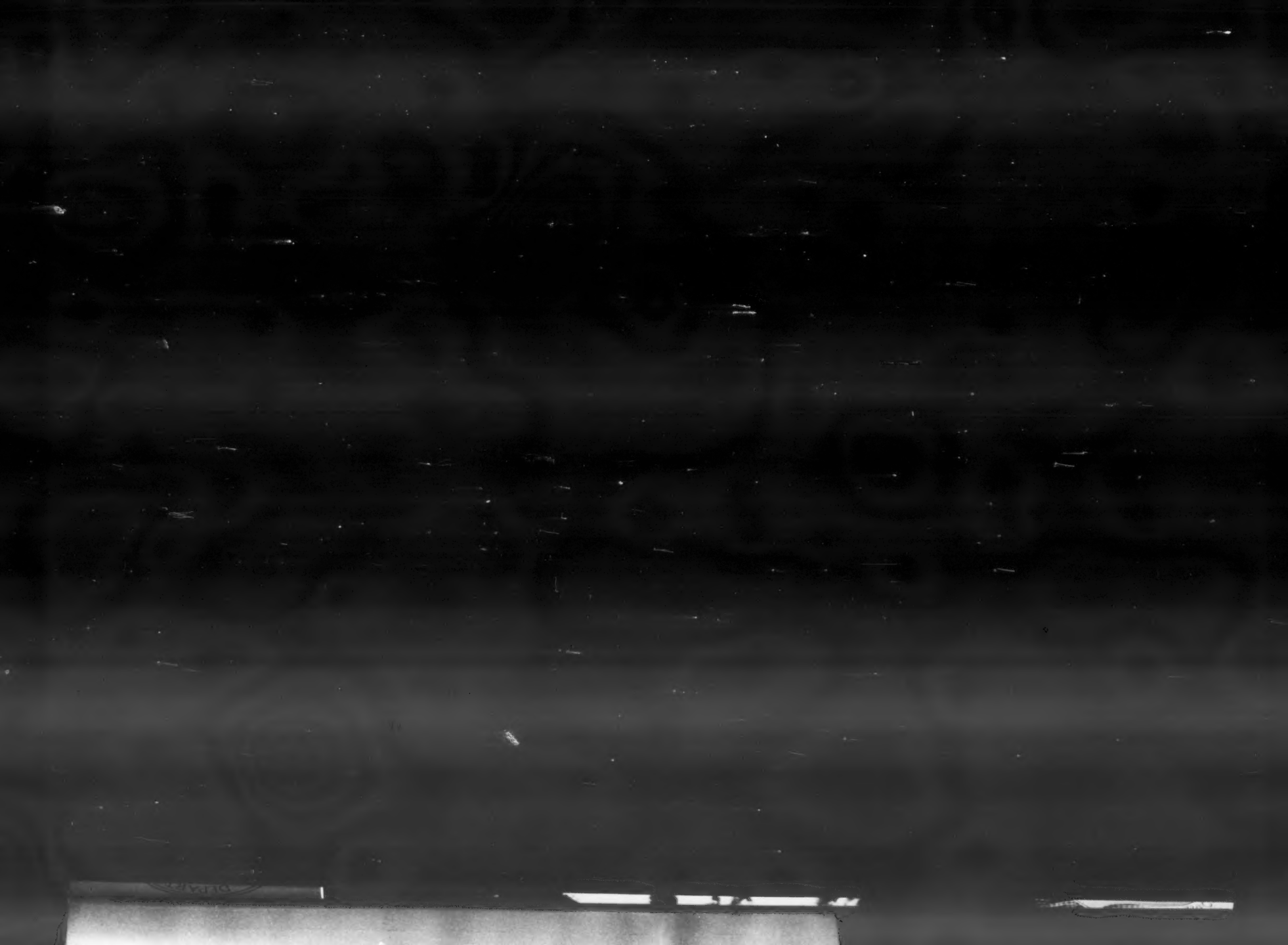


The Convair-designed observation satellite is designed to orbit indefinitely while studying the heavens and earth. At each end of its long central shaft are tank-shaped crew quarters. Long antennae protrude from storage and instrument compartments at middle of shaft. As it travels the whole satellite spins slowly to create artificial gravity through centrifugal force.



MAINTENANCE MAN

The warrior giant now idly sleeps,
Chained to the earth, the eagle stands,
The voice of power, now hushed and still,
Awaits the wakening of my hands.

And as I bid the pulse beat quick,
A pa[illegible] of strength triumphant roars,
The song of power fills all the world,
And in its voice, my spirit soars.

T/Sgt. John K. O'Doherty